The FOUNDRY

Volume 51
Number 4

Published
Semimonthly

CLEVELAND, OHIO, FEBRUARY 15, 1923

Bronze Towers Guard Avenue

Intimate Details of the Many Steps Involved in Their Production from the Creation of the Design to the Erection of the Assembled Piece of Architectural Beauty

BY E. C. KREUTZBERG

WHEN the Fifth Avenue association decided to present the city of New York with new signal traffic towers to replace the old experimental structures it also decided that no valid reason existed to prevent a piece of utilitarian equipment from appearing as a work of art. From the 130 designs submitted by eminent artists that of Joseph H. Freedlander, New York, received the approval of the municipal art commission and was accepted by the association and by the city of New York. Seven of these towers each 23 feet high constructed of bronze castings on a steel frame were ordered from the John Polachek Bronze & Iron Co., Long Island City, N. Y. Each tower contains 36 separate castings with a combined weight of 6000 pounds, or a total of 42,000 pounds for the entire set of seven. At this writing the first of the series has been erected at the intersection of Forty-second street and Fifth avenue and the others are in process of assembling at the plant of the fabricator. Mr. Freedlander based his design to a considerable extent on the belief that the display of creative art in the streets unconsciously affects the mind of the public and tends to create

FIG. 1—LEFT—EAGLES SURMOUNT EACH OF THE FOUR CORNERS NEAR THE TOP FIG. 2—ABOVE—TWO OF THE LOWER PANELS ON EACH TOWER ARE FITTED WITH CLOCKS AND TWO CARRY THE TRAFFIC SQUAD EMBLEM FIG. 3—RIGHT—A WINGED HOOF FORMS THE BASE OF EACH COLUMN

FIG. 4—BELOW—HOOF MOLD WITH UNDERCUT AND FALSE CORES REMOVED AND SOME OF THEM PINNED IN THE MOLD—THE SCREWS ARE REMOVED AND THE PATTERN IS LIFTED AWAY IN FIVE SECTIONS

FIG. 7—ABOVE—COMPLETED HOOF MOLD, SHOWING THE JOINT BETWEEN THE COPE AND CHEEK FIG. 8—BELOW—THE CHEEK AND COPE HAVE BEEN RAMMED, THE PLASTER MATCH HAS BEEN LIFTED OUT OF THE PATTERN IN FOUR SECTIONS AND THE MOLD IS READY FOR THE DRAG

FIG. 5—BELOW—FIVE OF THE 15 UNDERCUTS AND FALSE CORES ARE REMOVED BEFORE THE CHEEK IS TAKEN OFF AND THE REMAINING 10 ARE SHOWN STILL IN PLACE

FIG. 6—ABOVE—PATTERN FOR HOOF CASTING MOUNTED ON A PLASTER MATCH

imperceptibly an understanding and appreciation of what is beautiful.

In each tower the traffic officer's station is supported on four upright, hollow, 6-inch square columns 14 feet long, terminating at the bottom in symbolic winged hoofs which in turn rest on a base of Milford granite. The base is about 3 feet high and extends from the concrete sub-base to the level of the wing tips. The four corners are cut to conform to the shape of the hoofs and the flat space on each of the four sides is richly carved to represent garlanded flowers. The top of each column is in the form of an elaborately ornamented capitol supporting an eagle with wide spread wings. Conventionalized torches above the eagles serve to frame the signal lights.

The open work frame presents no obstruction to the view of motorists and others who use the thoroughfares. The traffic officer's station in the upper part of the tower commands an uninterrupted view north, south, east and west, and in addition presents an interesting example of conservation of space. Not only is the tower equipped with lights and other signals designed for the control of traffic but it also contains police and fire alarm apparatus, telephone connection, synchronized clocks, an electric heater and a stool for the officer on duty. It is claimed that the amount of wire employed in connection with the various electrical devices is sufficient to wire a 20-room house.

Making the Patterns

After the design had been accepted the architect made a set of detail drawings to scale. From these a set of full size drawings was prepared and delivered to Ulysses Ricci, a modeler who fashioned the various parts of the tower in plaster of paris with the ornamental detail in clay. To secure a true out-door perspective the plaster model was set up in the courtyard as shown in Fig. 9, where it was viewed and approved by the designer. The model then was disassembled and a gelatine mold made off each piece. These molds afterward served to form duplicate plaster castings which in turn were employed as patterns to form the bronze master patterns from which the working patterns were produced.

The foregoing method applies to all the patterns in a general way. In some it applies in its entirety and in others in a modified degree. For example the pattern for the upright column 14 feet long, 6 inches square 3-16-inch metal thickness was made of mahogany with the ornamental design in bronze screwed in place as shown in Fig. 11. The customary method of producing castings of this character is to mold and cast each of the four sides separately and then join them with concealed rivets. In this instance the casting was made in one piece partly for the appearance of the finished casting, but principally for economic reasons. The cost entailed in preparing a pattern to mold in this manner, when spread over a total of 28 castings, was more than offset by the time saved in making the molds besides the time and expense incident to jointing and riveting so many separate sections.

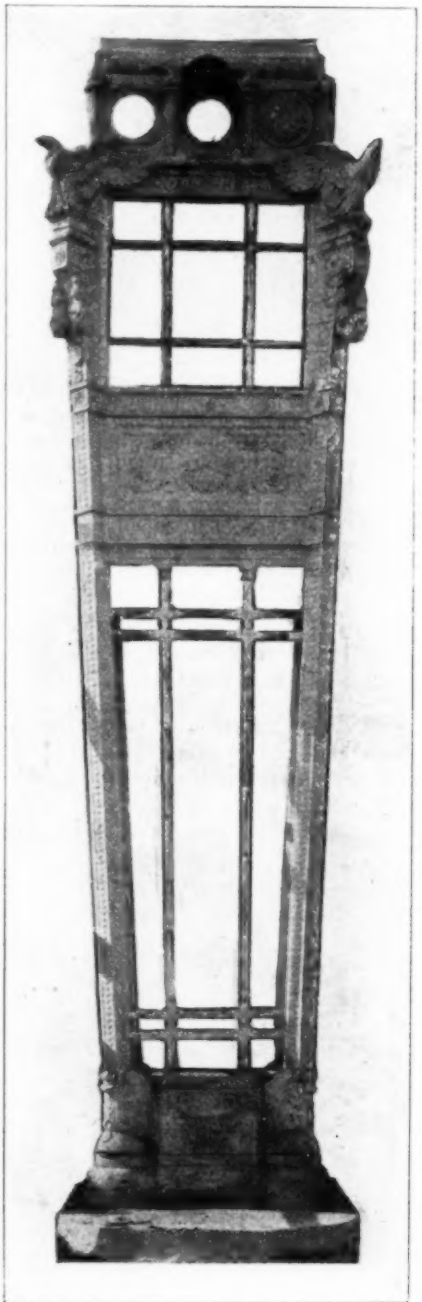


FIG. 9—COMPLETE PLASTER MODEL FOR THE FIFTH AVENUE TOWERS

The pattern carried an ornamental design on all four sides and therefore it would have been impossible to draw it out of the sand in the usual manner. The side pieces were prepared in three sections to facilitate handling and dovetailed on the main body of the pattern. The mold was made in a 2-part flask, 2 x 2 feet, 16 feet long. A mixture of Albany and imported French sand was used and the mold was skin dried. One molder made one casting every day until the order was completed

Side Pieces Drawn

In making the mold the assembled pattern was laid on a long board. The drag then was rammed and rolled over, after which the cope was rammed and lifted off. The center section of the pattern carrying the ornamental design top and bottom was drawn out of the mold. The side pieces, one section at a time then were drawn in laterally until the ornaments were clear of the sand when they were lifted out of the mold and reassembled on the main pattern for the following day. The long core, square in cross section, was supported in suitable prints at each end. Chaplets top and bottom prevented it from sagging in the center due to its own weight or from lifting under the pressure of the molten metal. Four ladles were employed to pour the metal which entered the cope through four runners and was distributed uniformly to the mold through a series of 24 gates, six to a runner. The intricacy of the ornamentation and the comparatively thin metal section required the highest degree of skill on the part of the molder in the production of the casting.

The hoof and eagle castings also present interesting examples of skilfull molding practice. Various stages in the molding of the hoof are shown in the illustrations Figs. 4, 5, 6, 7 and 8. The hoof pattern was an exact replica of the desired casting inside and out, that is it was designed to leave its own core. It was formed from five accurately fitted sections as shown in Fig. 6 so that it might be removed from the mold one section at a time. The involved character of the mold further may be inferred from the fact that no less than 15 drawbacks were required to permit removal of the pattern and although the casting only weighed 12 pounds a highly skilled molder devoted an entire day to the production of each casting.

The bronze hoof pattern was mount-

ed on a plaster match assembled in four sections to facilitate removal after the mold was rolled over. A three-part flask comprising a drag, cheek and cope, was employed to form the mold. The pattern, face side up, was adjusted on the plaster match where a large false core or drawback, was rammed on either side. This feature, although at a different stage of the process is shown in the foreground in Fig. 5. Eight small undercut cores also were rammed and then the cheek was rammed. Five small undercut cores were required above the cheek parting line and then the cope was rammed and the two parts of the mold were clamped and rolled over. The plaster match was removed in sections as shown in Fig. 8. The drag was set on, filled with sand including the cavity inside the pattern, rammed and then the three parts of the mold were clamped together and rolled back to its original position.

Taking the Mold Apart

The cope was lifted first, followed by the five small undercut cores. Then the cheek was lifted and the mold appeared as shown in Fig. 5. After the two large cores on the sides and the remaining eight small undercut cores were removed the pattern was lifted away in sections. The mold as it appeared before the pattern was removed is shown in Fig. 4. The small undercuts were pinned in their proper place and then the various parts of the mold were placed in the oven and dried. They were assembled the following morning and the mold was poured.

The mold for the upper part of the column supporting the eagle with one of the side cores in place and the interior core lying outside the flask is shown in Fig. 10. The casting weighed 86 pounds and was poured through two runners connected to two gates

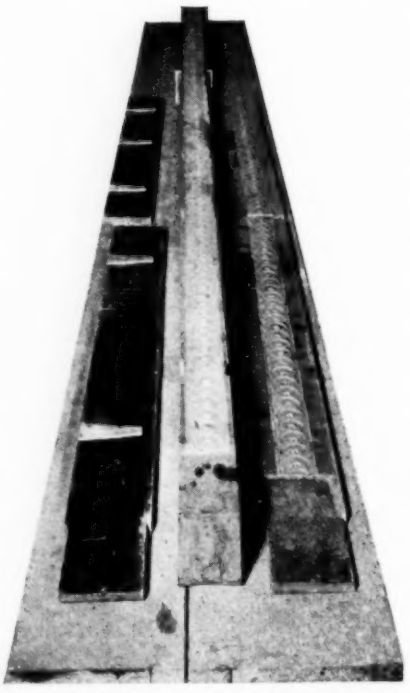


FIG. 11—PATTERN FOR BRONZE UPRIGHTS WHICH SUPPORT THE TOWERS IS PROVIDED WITH LOOSE SIDE PIECES IN THREE SECTIONS —AFTER THE MOLD IS RAMMED THE MAIN CENTER SECTION OF THE PATTERN IS LIFTED OUT AND THE SIDE PIECES ARE DRAWN IN—THE MAHOGANY PATTERN CARRIES THE ORNAMENTAL DESIGN IN BRONZE

each. One riser was taken off the high end.

The pattern and mold for one of the panel castings is shown in Fig. 12. The mold was provided with three risers in the center and was poured through four runners, each with a single gate on the perimeter. The casting weighed 160 pounds and the mold in common with all the others was made in a mixture of Albany and French sand and was skin dried. One of the panels ornamented with the traffic squad emblem of the New York police department is shown in Fig. 2. The mold for the top panel through which the signal lights shine is shown in Fig. 13. The mold was skin dried, was provided with three risers, one in each opening and was poured through two runners, each connected to four small, thin, flat gates.

Iron for Grinder Plates

Question—We should like to learn of a suitable iron mixture for grain grinder plates. These plates are circular, about 3/8-inch thick and are covered top and bottom with diamond shaped corrugations. The upper edges of the corrugations must be sharp and it is essential that the plates be exceedingly hard and strong and have a long life.

Answer—Iron of the following composition will make satisfactory plates for the purpose indicated: 40 per cent No. 2 foundry pig iron, 20 per cent steel scrap, 20 per cent hard iron scrap, 20 per cent car wheel scrap. On account of the low silicon and phosphorus content this iron is inclined to be a little sluggish and therefore it is necessary to melt it exceedingly hot to get a sharp impression on your thin corrugated plates.

The Marion Brass & Bronze Foundry, Marion, O., has completed a steel and concrete addition to be used for brass melting room and metal storage. R. A. Lau is general manager of the company.

FIG. 10—BELOW—MOLD FOR CASTING FOR SUPPORTING THE EAGLE—NOTE THE CORE IN THE FOREGROUND FIG. 12 —RIGHT—MOLD AND PATTERN FOR LOWER PANEL

FIG. 13—MOLD FOR THE UPPER PANEL

Compares Molding Practices

Considering European Versus American Molding Machines Points of Difference Are Brought Out and Hydraulic Equipment Is Shown To Have Advantages and Disadvantages Over Compressed Air Operation

BY E. RONCERAY

ONE point which strikes an American observer who visits European foundries, is the small use made of compressed air as a motive power, and on the other hand the considerable extension of hydraulic pressure, a factor practically unknown in American foundries. The reasons for this are simple and of prime importance. Compressed air at a pressure at from 60 to 100 pounds does not allow of the obtaining of high pressures on the molds and from this fact one can only use it for the making of small molds. For such work it is both rapid and practical but it is not good from the point of view of pattern drawing. In short, it is incapable of giving steady and controllable movements. Thus allowance is made by means of some intermediate element to obtain the withdrawal of the pattern on precision lines by the use of an oil brake, specially designed hand starting mechanism, or by similar equipment.

The leakages of compressed air into the atmosphere are not troublesome, but for this reason, they are neglected with the result that the power lost through them is often equal to or more important than the power actually utilized. A. Wardle* says, "It is important to stop the smallest leakage in the pipe system. A ¼-inch diameter round hole would allow air at 100 pounds pressure to escape at the rate of 100 cubic feet per minute, and 20 horsepower would be required to enable the compressor to cope with this leakage." However, by its nature compressed air is not economical, as the average motive power absorbed by each compressed air machine is from one to several horsepower and the section of the pipes is from one to several inches.

Water pressure on the other hand utilizes pressures varying from 750 to 1500 pounds per square inch. At these pressures, from eight to twenty times greater than those of air, the piston sections remain rather small, even for the higher pressures, consequently up to the largest molds, the sizes of machines and prices can be kept within reasonable limitations. Water at high pressure at the same time makes for a low consumption and a high speed of water in the pipes, which therefore can be made of a small section.

In a carefully designed machine the water consumption is low and the motive power absorbed is not excessive. Thus it is quite usual practice to work 20 molding machines at full output with a 5-horsepower pump, the main pipe being copper piping ⅞-inch inside and 3/32-inch in thickness. The water lends itself at the same time to rapid movements for the ramming and to the initial slow movements and then more rapid and steady movements for the pattern drawing. It is quite unnecessary that there should be any complication, and the most diverse movements can be obtained by small dimensioned parts.

Water leakages are troublesome, and obviously they require immediate attention which does away with both water and motive power losses. However, they may be avoided by the use of well made piping and leather or rubber joints for the fixed parts, and high class packings for the moveable parts. The most important inconvenience is the freezing in cold weather, but it must be considered with no more importance than it deserves. First

Paper prepared for the Rochester meeting of the American Foundrymen's association.

*Paper delivered before the Birmingham branch of the Institution of British Foundrymen, April 2, 1921. *Foundry Trade Journal*, June 2, 1921, p 499.

FIG. 1—SMALL HAND MACHINE MAUFACTURED IN FRANCE

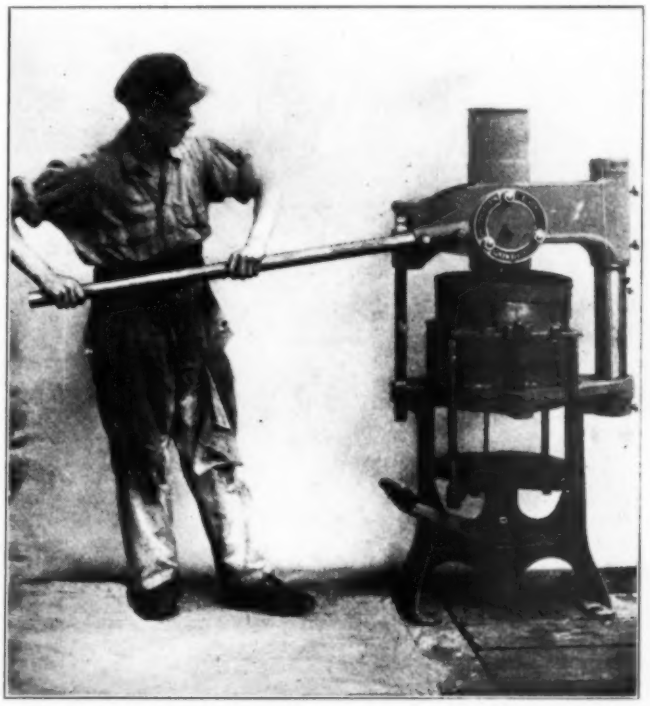


FIG. 2—FRENCH MACHINE OPERATED BY A LONG LEVER

of all, a water return pipe and a non-freezing mixture can be used. All the types of water piping in towns and factories show that this inconvenience is more a talking point than anything else. As a matter of fact, the temperature ought never to reach freezing point in foundries, because it is quite obvious the sand would freeze, and all work would automatically stop. Also, it is possible to empty the pipes or to use a non-freezing mixture. On the other hand, new machines described in this paper are so laid out that all the hydraulic sections are underground, which practically precludes any chance of freezing, the pipes being naturally underground also. Compressed air too, is not entirely free from frost troubles, for in the air pipe important condensations take place and the cooling due to air expansion may transform them into ice.

Throughout the technical press, and in a few recent books, will be found constantly repeated a false aphorism that is repeated as many printed things are, that jarring machines "are ideal as far as ramming is concerned."

We cannot possibly subscribe to this statement and we differ with the opinion expressed by many American foundrymen with whom we have talked, that when pressure ramming is possible, it gives in the large majority of cases results superior to the jarring machines. We admit, however, that in a few limited cases the jarring machine can show advantage. It is an established fact and one which is easy of proof that an ordinary mold is better and more quickly rammed by pressure than by jarring.* This we will show later on, but the fact that the number of pressure machines used in America for small and medium size molds are in outstanding majority, is sufficient proof.

It would be interesting to learn, therefore, why jarring machines are in favor for large molds in America. Basically it is solely due to the impossibility of ramming large molds adequately by pressure, on account of the low pressure of the fluid usually employed. The skill of American engineers has turned to use the dynamic effort produced by the impact of a mass raised by compressed air and falling down on an anvil, in place of the static effort derived from simple air pressure.

It would be probably difficult to come to a unanimous agreement upon what constitutes ideal ramming, for the foundry still remains in a state so empirical that every individual is possessed of an opinion on this subject, with more or less reason. It is perhaps possible to accept a statement that it would be rational that the hardness of the mold is proportional to the pressure of the metal, that is rammed softer from the bottom to the top of the mold, so that under such conditions the gas will escape through the sand in a regular manner under the variable pressure of the column of metal.

Taking as an example a split axle box, if we show darker the portions of the mold which are rammed the hardest, it will appear something like Fig. 3, a sketch for a mold rammed by a jarring machine. For the drag it is exactly the opposite of what is required and if for the cope it is good for the joint it is bad for the higher portion of the casting. Unfortunately no means exist to do otherwise. On the other hand, pressure ramming permits the operator to vary at will the pressure on the mold. This is not all, it is a recognized

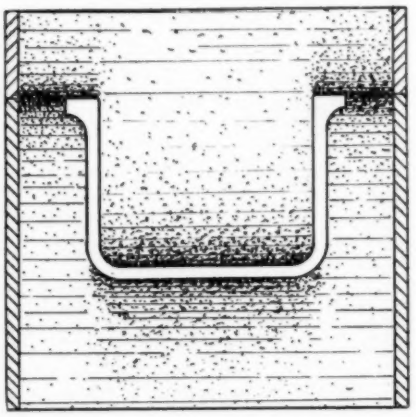


FIG. 3—SKETCH SHOWING DENSITY OF SAND IN A MOLD RAMMED BY A JARRING MACHINE

fact that the shocks of jarring machines give much trouble in the foundry* and the number of highly ingenious contrivances which are supposed to overcome them merely show the number of troubles they cause. As a direct corollary, the bending of the flasks when working on flat molds renders the work extremely difficult, also the rebounding of the sand which occurs renders the molding difficult, especially for flat molds. Finally, jolt ramming produces soft spots in sharp angles and under bosses.

Jarring Has Advantages

If, in spite of all these inconveniences jarring machines have assumed so great a development in America, it is because they have not only inconveniences, but they show also some advantages. These advantages are especially evident in deep molds, the bending of the flasks being completely compressed. Under these conditions the rebounding is less dangerous. The differences of hardness from the lower to the upper portions of the mold are not so marked, and the packing of a huge mass of sand under these conditions is satisfactorily accomplished. Jar ramming does not necessitate the use of special ramming plates having the shape of the flasks as in pressure molding and in consequence no preparation whatsoever is needed for fitting the pattern for the machine. It is thus possible to use the jolt machine for short runs, principally to ram, the pattern drawing being accomplished either on the machine or elsewhere. However, it is a simple process, easy to understand by men used to hand molding who only see in the use of the machines a method of reducing their fatigue, all the remainder of the work being carried out similarly to hand molding. Briefly expressed, if compressed air pressure permitted the easy ramming of large molds, it is highly probable that the jarring machine would not have assumed such a great development, and we do not hesitate to say that in a country like England where compressed air is not extensively used in foundries, and where hydraulic power is used as an everyday matter, it was a false step to have exploited the jarring machine rather than to have preserved it for special cases where it shows outstanding advantages. Jarring machines also permit the ramming of deep and narrow spaces in patterns such as those for long ribbed heating pipes, which, however, American molding machine makers declare impossible of attainment up to now.

The use of squeezer machines has not always been understood. It is extremely easy to ram deep flasks with squeezer machines by carrying out the operation in several stages. Usually two squeezings are sufficient, and as this work of pressing is rapid, and once made, the work is not partly but entirely finished without the necessity of butt ramming, striking off, etc. It readily will be seen that there are found in many cases distinct advantages from the use of the squeezer machine, even for the deepest molds, notably where pattern has projections, bosses, loose pieces and the like. European practice, particularly French, differs considerably in this respect from American practice.

While in America the aim has been to simplify machine molding by the employment of as many exterior and interior cores as necessary, in France the trend of affairs has been to keep the number of cores, especially of a complicated nature, to the strictest minimum. By this method of working the cost price is reduced, for cores are expensive both in material and labor, and what is still more serious they give rise to complicated core setting and ugly fins which have to be fettled by hand at a price which is sometimes three or four times greater than the total value of

*W. L. Lewis, lecture before Franklin institute, May 18, 1911.

*W. Lewis lecture before Franklin institute, May 18, 1911, p. 24. "It is not generally safe to set up finished molds with hanging sand in the neighborhood of a jarring machine of this type and in some foundries the jarring machine has been out of service for days or weeks pending the completion of large floor work. In fact, the damaging effect of large jarring machine is too well known to need confirmation and to reduce this to a minimum, the drop of the table has been decreased while the foundation has been increased.

the mold. Much cleaner work and a much lower cost price is obtained even though the production by the machine may be less, than if the molds made were merely to hold cores for forming the shape of the casting.

The objections generally associated with squeezer machines are usually due to ignorance as to the best means of carrying out the operations. It is common to find a foundryman new to the molding machine game who expects to produce machine molds by employing the same sand and by following the same method of working, etc. as he does in hand molding. Little by little machine molding methods have been involved and are distinctly removed from hand molding customs, so much so that the digression has become enormous and perplexes the most open minded persons. On the other hand, however, progress which has been made with regard to machine molding undoubtedly has thrown much light upon hand molding.

Patterns Accurate

On account of the incompetence of men operating machines, it is the custom not to permit them to patch the molds. The pattern plate must be perfect and the pattern drawing accurate enough to give a perfect mold requiring no patching. Such a perfection in working conditions allows of the use of a much dryer sand, the dampness essential for patching by hand being no longer necessary. Gradually the possibility of using dry sand has been recognized and has made possible the use of a dry sand which flows better under pressure, that is to say, which approaches in this respect silica sand, which as everybody knows runs like water when it is perfectly dry. The ramming is thus accomplished under much better conditions than with a damp sand, but this is not everything. The dry sand which rams better, consequently no longer necessitates the use of a presser head close to the moderately restricted or deep parts, but a simple finger touch before the squeezer ramming is sufficient. It does not scab and it remains so permeable that it is practically unnecessary to vent the molds. These new and highly interesting conditions have been brought about by the every day machine molding practice, and are too precious not to be profited by when molding by hand.

In the author's demonstration foundry which has been placed at the disposal of foundrymen, they are invited to take particular notice of the apprentices using for green sand molding practically the same sands as those used for machine work, and using little or no peen ramming, merely the hand tucking and the butt ramming and not venting. If sand breaks, it is damped only where broken and even then to the least extent.

This example is only one of the aspects of the question. Many others present the same divergence between old-time methods, and those resulting from a systematic study of mechanical molding.

Thus the question resolves itself into the following:

A—For all molds small or medium, relatively shallow, squeezing is to be selected.

B—For all molds small or large, low or deep, where the pattern drawing is most important and for those where projections and numerous loose pieces are used the pressure ramming is to be selected even when it involves ramming by two or more squeezings.

C—For large flat molds jar ramming presents great difficulties. Jarring machines are, however, to be recommended where there is a special difficulty of ramming for which it is specially convenient (large number of narrow pockets of sand) in spite of the difficulties mentioned.

D—For large molds, of deep and simple castings in which the pattern drawing does not necessitate any great degree of precision, or when there are few molds to make, jar ramming is to be recommended. The finishing is mostly made by hand.

E—Water pressure is desirable in all cases for pressure machines, it alone permits of pressure ramming large molds.

This means that where hydraulic pressure is used, the pressure machine exhibits distinct superiority. The combination of the two methods of ramming can give good results, and it is at all times desirable that the pressure maintains the chief feature, which is rarely the case in existing machines.

A foundry exhibition was held at Munich from Sept. 14 to 21, in 1921, but unfortunately only a few machines were working. The outstanding feature of this exhibition was the complete absence of originality in any of the types on show. On the other hand there were to be found more or less cheap imitations of American machines, as regarded jarring machines, and of French machines, as regarded the pressure type. Additional to this there were shown some simple pattern drawing machines the main feature of which mainly consisted in the pattern plate, and some pressure machines actuated mechanically or electrically, of which the principle is bad, because of the fact that the purely mechanical working is scarcely adaptable to the inevitable contact with sand, and on account of the multiplicity of the variability in the stroke and speed of the movements necessary to molding machines, and not showing any advantages over the use of a fluid as intermediary.

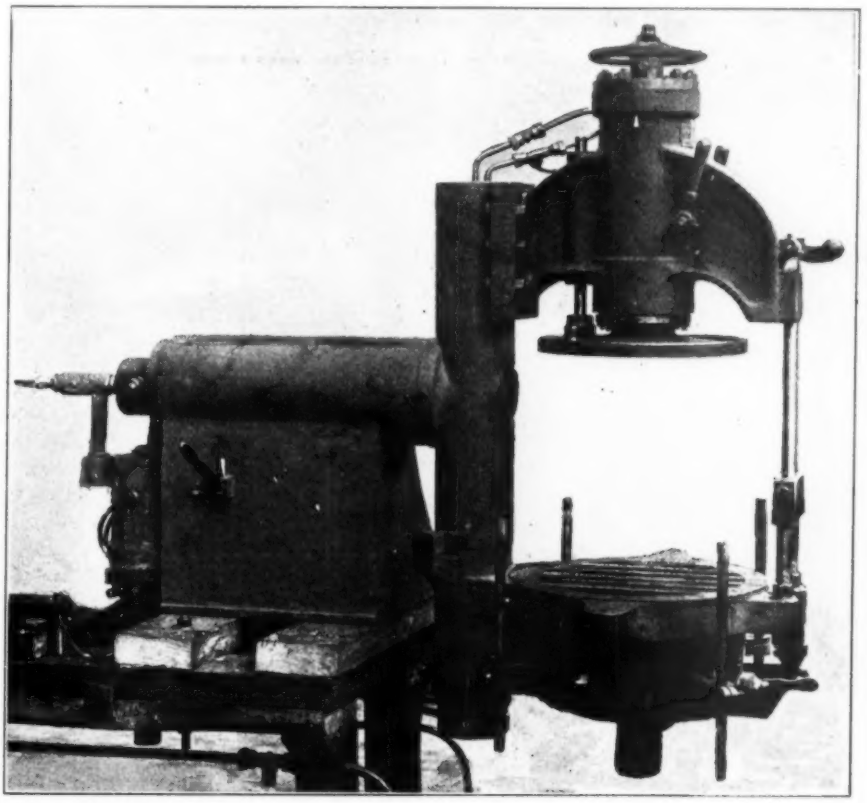


FIG. 4—EXAMPLE OF A TURNOVER MACHINE MADE BY A FRENCH MANUFACTURER—NO PIT IS REQUIRED IN FRONT FOR ROTATION

Electric and other types of jarring machines were most numerous. Some were actuated by a simple cam in a similar manner to an American machine, while others inserted springs between movement and table.

General criticisms can be given of the

German jar ramming machines which are actuated by a motor. The strength of the blow cannot be regulated, which is a distinct fault. This force should be able to be varied according to the weight of the casting to be made, the depth of the flasks and the type of work. Finally, tables on springs cannot be leveled accurately; consequently pattern drawing is more or less inaccurate.

Machines manufactured in England have been fairly completely described in the paper by H. Cole Estep. It only seems necessary to add that some of the types made by A. Marillier. The column and hook are adjustable so that available height between table and presser head can be altered.

The firms of Baillot and Utard make hand machines similar to this. The Utard machine for large molds is worked by two levers.

Fig. 2 refers to Bonvillain & Ronceray hand molding machines. Ramming is obtained through a long lever working a pinion and a rack. It can be adjusted by setting the three bolts shown in front in a circular groove cut at the end of the pinion shaft. Pattern drawing is made through a pedal shown on the side of the machine.

One firm, Glaenzer & Perreaud, manufactures Nicols pneumatic machines. Another makes, on a small scale, jarring machines with a cam based on the American principle. They are designed by an engineer who has passed a portion of his life in America. A third, Gailly, manufactures a hydraulic machine, in which the two parts of the flask are rammed side by side for the production of flat castings.

The Diederichs concern makes types of hydraulic machines with turnover tables, which have been manufactured for a long time by German firms, and by the French concern of Desmarais & Morane incorporated some 10 years ago by the Bonvillain & Ronceray company. This latter firm, which during the war was, above all, taken up with the intensive supply of material necessary for the manufacture of cast-iron shells, has now returned to its normal manufactures and it may perhaps be interesting to pass in review the most recent types of its different machines of which the general construction is different from any American, British or German designs. Because of the scarcity of mass production in France, it has been necessary above everything else to create methods of making pattern plates, allowing of the making of these pattern plates at a low price, and relying largely upon molders' work.

A pattern plate is made of metallic shell, and its stripping plate, both are made in one single casting. This obviously ensures an absolute registering between the pattern and the stripping plate. The stripping plate and the pattern plate are detached by means of a fine chisel, which allows a tiny play around the pattern. This represents an extremely simple case. The work would be the same, if instead of a double pattern plate, that is to say one allowing for the separate molding of the upper and lower flasks, it was necessary to make a reversible pattern plate.

The most complicated castings can be made by similar processes. An example

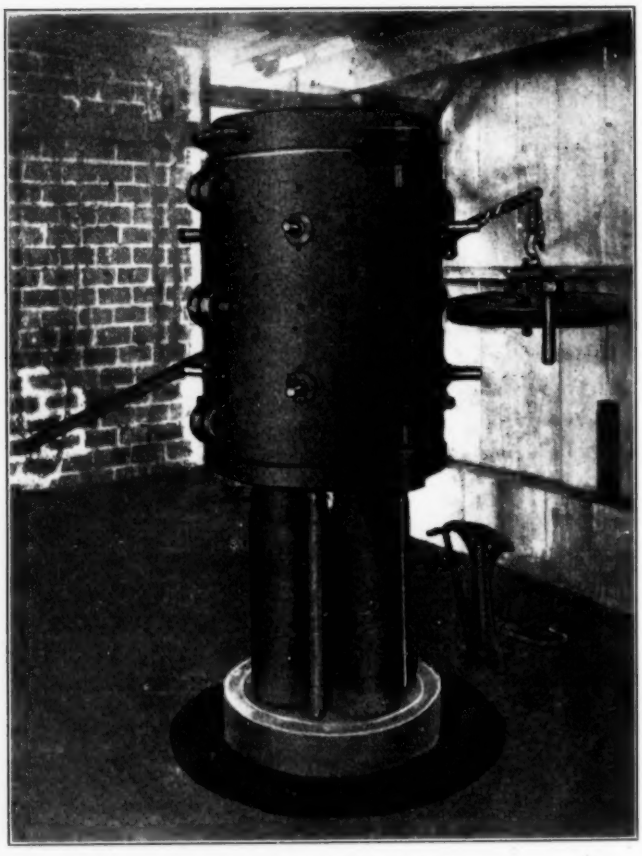


FIG. 5—FRENCH MACHINE EQUIPPED FOR MAKING SHELLS

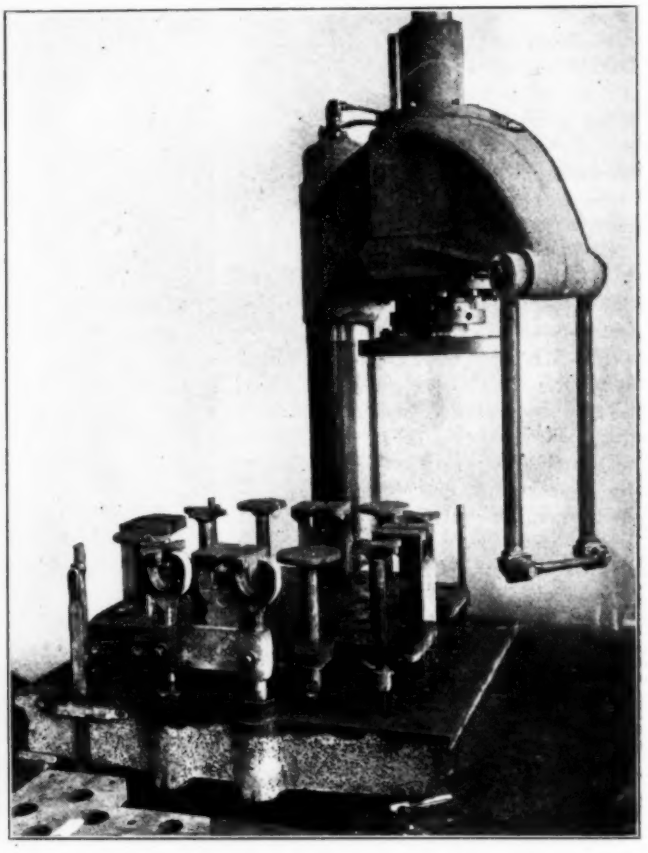


FIG. 6—ROLLOVER MACHINE OF FRENCH DESIGN, 48 INCHES BETWEEN COLUMNS AND HOOK

which were not mentioned are fairly well known.

As mentioned by H. Cole Estep in his paper before the American Foundrymen's association at the Columbus meeting, there are in France only a restricted number of manufacturers of molding machines. There are, however, nearly a dozen, but if the number of designers is restricted, the number of machines constructed is relatively important, and the machines manufactured are noted throughout the entire world.

Some half-dozen manufacturers are specialists in hand-operated machines, and turn out excellent types, which are really quite different from those constructed in either America or England.

Fig. 1 represents a small hand machine

is a dynamo frame, made on the machine leaving its central core in the mold. It is one of the extremely rare cases where the peg rammer should be used to ram in the interior parts of the core. In the pattern plate are a number of loose pieces, which permit the making of a complicated casting without hand made cores, and without fins on the castings.

Make Important Progress

With reference to turnover machines, Bonvillain & Ronceray have also made some important progress, as shown by Fig. 4. This machine is similar to the previous ones, with the difference that it does not require a pit in front to permit the rotation of the machine. The machine does not rise above ground level, and in consequence its use is rendered more handy, but its capacity is slightly less, its ramming stroke and pattern-drawing arrangement are only 12 inches, instead of 16 inches, which correspond to the dimensions of fairly large molds.

Instead of being provided with a swinging head, the table rotates round the column and is thus brought to the side of the machine, giving an arrangement, which is advantageous, when it can be used, so that the table is in position near to the sand-heap. On the other hand, it is not easy to have a pattern-drawing arrangement with such a long stroke.

The rolling over of the machine is obtained by means of a cylinder, and one single piston worked by a lever, which is clearly shown at the side of the machine. A hand wheel situated above the pressure head is used for regulating the stroke of the ramming plunger. This machine has a slightly smaller capacity than the preceding one but is quicker in its action.

As indicative of the sizes of the large machines normally manufactured, Fig. 6 shows a machine having 48 inches between column and hook, and the rotating machine, Fig. 7, having 55 inches between column and hook.

The most recent model of the type, shown at Philadelphia in 1907, does similar work, to the split patterns and stripping plates machines of the American designers, but are suitable for variable sized boxes, which is not the case of the American machines.

The outstanding feature is the total elimination of joints, connections and piping in the machine. All hydraulic arrangement is under the table, and in consequence there is no necessity to have apparatus to bring the water to the head of the machine. Moreover, the water is brought to the lower cylinders by means of holes drilled through the cast iron, so that keeping up is very simple and the dangers of frost completely eliminated. Their simplicity and ease of service are remarkable.

One lever only works all the movements.

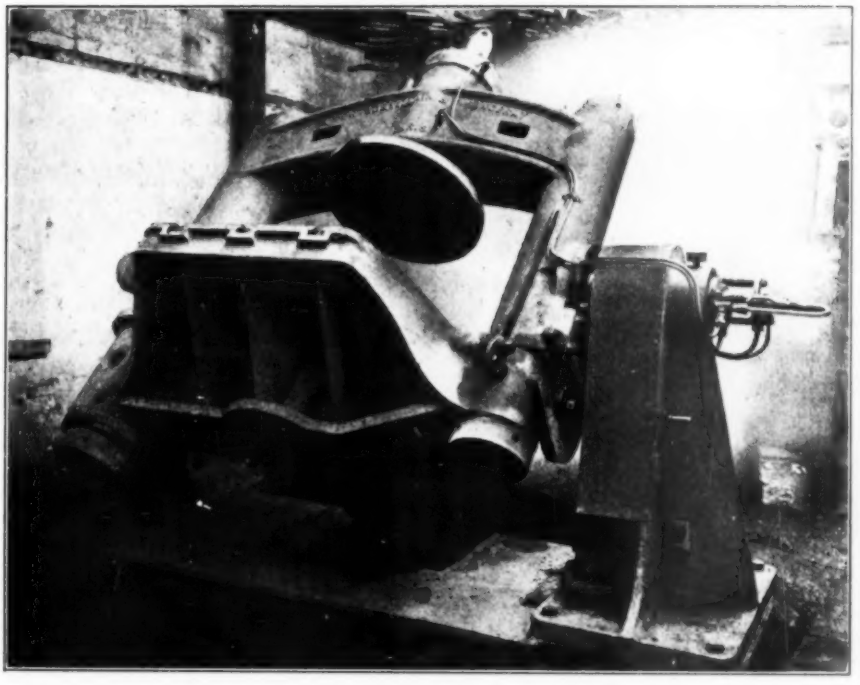


FIG. 7—ANOTHER MACHINE SIMILAR TO THE ONE SHOWN IN FIG. 6—THIS HAS 55 INCHES BETWEEN COLUMN AND HOOK

By pushing to the right, ramming is effected, while a motion to the left withdraws the pattern. In the middle position the two movements are neutralized. The pattern drawing can also be effected by a pedal fixed to the lever.

This firm manufactures interesting jar-ramming machines, based on a principle entirely different from those made up to now. They are machines which are provided with mechanical hydraulic movement. Fig. 5 shows this machine fitted for making shells.

In his communication to the Franklin institute, W. Lewis states that in order to overcome the difficulties coming from the top of the box, and the pattern being not rammed equally, "bottom ramming machines in which the patterns were pushed up into the sand, were recognized as ideal in principle, and they were used with more or less success. But the method is opened to the objection that it necessitates a predetermined quantity of sand reduced in bulk by a definite amount of compression and these conditions upon which success depends are not always realized in practice." In reality these difficulties are much less when sand as dry as possible is used in the machines.

Bottom ramming, which we call "down-sand frame," because, instead of raising the patterns, the box is suspended on a movable frame and is made to descend, is only recommended in a limited number of cases, for the pressure of dry sand is transmitted sufficiently well to render useless such arrangements especially where the production is not extremely large. But in the last case, and for special applications it is superior in point of speed and workmanship to any other system and especially to jar-ramming machines.

This arrangement has only one disadvantage, that is, it necessitates relatively costly and complicated accessories. On the other hand, once these accessories are provided, the production is considerable and the work is accurate. Ramming and pattern drawing are made with a single ramming stroke, the mold being in these conditions completely finished, even if there are a limited number of narrow sections in the mold because there can be used for ramming in such sections a bar of suitable shape in the box, and even to ram on the side of the pattern, sloping sides boxes. Under such conditions there can be made railway-chairs, which need lateral ramming at the same time as the inside ramming in the rail sections.

Boiler Company Buys Plant

The Universal Smokeless Boiler Co., Ravenna, O., has purchased the plant of the defunct United Roll & Foundry Co., of the same city. The plant will begin operations with a capacity of seven to eight boilers per day. George W. Franzheim is president of the company; Robert H. Holden, vice president; Wright Hugus, secretary; Edward Clause, factory manager; R. Stargell, assistant factory manager.

Homer L. Rank has been appointed sales manager of the coal pulverizing division of the Bonnot Co., Canton, O., effective Feb. 1.

Gives Points on Die Casting

Two Types of Machines Used Depending on Method of Application of the Metal—Proper Venting and Gating Essential—Characteristics of the Different Die-Casting Alloys Are Noted

BY CHARLES PACK

DIE castings are metal castings made by forcing molten metal under pressure into a metallic mold or die. When pressure is applied to force molten metal into a metallic mold, as in the die-casting process, the resultant casting will not be as dense nor as closely grained as the general alloy. This gives rise to one of the defects that must be considered when contemplating the use of die castings. This defect is commonly called *blow holes*. When a die casting is broken examination of the fracture by the naked eye will show the outer portion of the metal to have a fine, close grain, but in heavy sections, distinct blow holes of variable sizes are found at the center. The elimination of this defect in die castings has occupied the attention of investigators for a number of years, but a solution of the problem has not been found. No machine or process for die casting has been devised that produces uniformly solid castings. By proper attention to the design of the machine, to the design of the die and to the alloy, blow holes may be reduced to a minimum, and on some simple parts blow holes can even be eliminated. Where it is absolutely essential that the casting be uniformly solid throughout, the die casting process should not be considered as a method of manufacture.

Blow holes in die castings may be attributed mainly to two causes. The first of these is the fact that in the die casting process the metal is forced into a metallic mold under a pressure of approximately 400 pounds per square inch. The first metal entering the die chills around the inner form of the die, closing up all vents, and the remaining metal must fill in from the inside. It can readily be seen that under these conditions thin sections will be cooled before the heavy sections, preventing a venting of those heavy sections, thereby producing voids or cavities in the heavy sections. Another frequent cause for blow holes in heavy sections of die castings is the phenomenon that is generally termed piping. It is a well known fact that where liquid metal is converted into the solid form a reduction in volume occurs. This reduction in volume is shown by a shrinkage in that part of the metal that was cooled last. When molten metal is forced into a steel mold the metal cools from the outside, the center of the casting being the last place to cool, and the shrinkage will naturally be in that place.

Paper read at a recent meeting of the Cincinnati section of the American Society of Mechanican Engineers. The author, Charles Pack, is connected with the Doeler Die Casting Co., Brooklyn.

Avoids Blow Holes

Blow holes are not encountered with castings made by pouring molten metal by gravity into a metallic mold. Castings such as aluminum pistons, where it is essential that they be free from blow holes, are made by this process, but are not die castings in the sense that the term is used here, or is understood by engineers throughout the country.

By referring to the definition for die casting; that is, metal casting made by forcing molten metal into a metallic mold or die, it readily may be seen that three factors are essential to the successful operation of the process: First a machine or appliance capable of containing the molten metal and applying the pressure to the metal; second, a die or metallic mold properly constructed capable of receiving that molten metal; third, a metal or alloy suitable to the machine and the die. It is difficult to determine which of these three factors is of predominant importance. The finest die-casting machine will not produce satisfactory die castings if a die has not been designed or constructed properly. Similarly, no die-casting machine with a well constructed die can produce satisfactory die castings if the alloy is defective.

The machines used in the die-casting practice conveniently can be divided into two groups, the plunger type and the air type. The plunger type of machine consists primarily of a cylinder and piston submerged in molten metal. An operating mechanism is attached to the piston and a slot is provided in the cylinder that acts as a valve which is opened and closed by the movement of the piston. This allows the metal to fill into the cylinder and that metal is forced into the die by a force applied behind the piston. A good illustration of this type of machine is the casting mechanism that is used on the modern linotype machine. The plunger machine produces satisfactory castings from alloys which fuse below 800 degrees Fahr. The alloys of zinc, tin and lead come under this classification. If alloys of higher melting point are cast in the plunger machine it will be found that the plunger will either freeze or stick, or that the plunger and cylinder wall will be dissolved with such rapidity by the aluminum that it is impossible to maintain a high pressure back of the plunger. The air machine consists of cast iron container, capable of holding molten alloy, and which will stand a pressure of from 200 to 400 pounds. An inlet is provided for air and an outlet for the metal. The metal is forced into the die by the application of the air under pressure to the surface of the metal.

The design and construction of the die is a factor that must be given careful attention in the manufacture of die castings. Three points are of general interest and common to all dies. They are:

Gate of inlet for the metal;
Venting of the die;
Ejector pins.

The location of the gate as well as the size and shape of gate are all vital factors in the production of die castings. In choosing a place for the gate it is well to bear in mind that that gate must be subsequently cut off from the castings and filed or machined to the surface of the casting. Therefore, where a part has to be polished it is advisable to put the gate or inlet where that filing or machining will not be objectionable; in other words, the gate should be placed at a point that requires no polishing, if that is possible.

The proper venting of the die will determine the solidity of the casting and quite often aids in improving the finish. Dies may be vented in a number of ways; first, by milling recesses where any two blocks are joined; second, by clearance in core

pins or ejector pins; third, by special overflows or risers.

Ejector pins are used in all dies for ejecting castings from the die and die castings can be readily distinguished by marks left on the casting in ejecting. The ejector pins will, in ejecting the casting, make a slight depression on the casting. If at a place where the casting meets with another part the depressions may not be detrimental. However, if that surface is to be polished, these depressed ejector pin marks are objectionable. For that reason, ejector pins are kept somewhat below the surface of the die, when the surface ejected is to be polished. This means that instead of having a depression, a small raised spot is produced on the casting that can readily be ground off when polishing.

Inserts Cost in Die Castings

No definite rule can be laid down for the design of any die or die-cast part. The engineer must bear in mind that as a general rule undercuts cannot be cast unless some means is provided for removing the undercut part after the casting is made. Quite often ways and means can be found to die cast a casting that has undercuts or pockets that look almost impossible from a die-casting standpoint, if sufficient attention is given to the design of the die. One of the important points to be considered in the design of dies is the use of inserts. Inserts may be used in die castings for some of the following reasons: First, to add strength or other physical properties in some local point of the casting; second, to provide specific electrical properties in some localized sections of the castings, as is accomplished in the casting of magneto bushings in magneto housing; third, to facilitate and reduce the cost of assembling two or more parts; fourth, to cast bronze bushings at points where good bearing qualities are desired; fifth, to cast into the walls of the casting tubes made of copper or bronze to provide lubrication to points that are not readily accessible.

Costs Are Raised

Cost of dies depends on the number of castings required in a given interval, since this determines the number of impressions that are to be placed in the die; also on the accuracy required of the casting, since the cost of producing a die requiring high accuracy will be greater than the cost of producing the same die with broader tolerance.

In ordering a die for the manufacture of die castings it is important that the engineer be sure of the accuracy of his design, since it is usually an expensive procedure to change the die after it has been made. It is well to bear in mind that it is a simple matter to reduce the diameter of a hole, since that means machining the core down, but it is difficult to increase the diameter of a core, which involves the making of a new core. Also, as a general rule, it is impossible to remove stock from a casting as that involves building on to a die, although it is comparatively simple to add stock to the casting, since that only involves machining further into the die. However, there are exceptions to the foregoing rules that are dependent entirely upon the design and construction of the die. The life and cost of maintenance of the die depends to a large extent upon the type of alloy used. The life of a die for zinc, tin and lead alloys is practically indefinite. For aluminum, the life of a die may vary from 25,000 to 100,000 castings, depending upon the shape and size of the castings. As a general practice, the die-casting manufacturer will make only one die charge and will replace the die at his own expense, should the die fail in service.

The cost of die castings depends, of course, upon the type of alloy used, and varies with the fluctuations of the metal market. No definite rule can be laid down to guide the engineer in judging the cost of a die-casting in advance and no reliable comparative figure can be given of the cost of die casting, as compared to sand casting. As a rule a die casting cannot compete with cast-iron sand castings, unless a number of machining operations can be saved. With few exceptions die castings cannot compete with simple screw-machine or sheet-metal punching work. The cost of die castings are generally determined by the following facts: First, the quantity required in the order; second, size, upon which will depend the amount of experience the operator of the machine can acquire on the job; third, the number and location of cores in the casting, since upon that will depend the multiplicity of the die, by which is meant the number of impressions that can be placed into the die; fourth, the accuracy required, as where a high degree of accuracy is demanded more care and attention must be given to that part while in process; fifth, the finish required on the casting, because where a part is to be polished, a slight surface depression would be objectionable and would cause a larger number of rejections of castings requiring a good finish.

The alloys used in the die-casting process may be conveniently divided into four groups according to the metals forming the base. These are aluminum, zinc, tin, lead.

The strength of the alloys used in die casting, may be classified relative to their strength, in the following order; aluminum, zinc, tin, lead.

The accuracy to which the casting can be held is dependent upon the melting point of the alloy, and can be rated in order as tin, lead, zinc, aluminum, the first, having the lowest melting point, can be cast to the highest degree of accuracy, and so on in their order. When the noncorrosive properties of the alloys are compared the order will be tin, lead, aluminum, zinc.

Form New Pipe Company

E. M. Rhoads has disposed of his interests and resigned his position as president and treasurer of the Sanitary Company of America, Linfield, Pa., and with other associates from the former company has formed the Eastern Foundry Co., Boyertown, Pa. The new company will specialize in the production of cast iron soil pipe, soil fittings and iron plumbing specialties.

The personnel of the Eastern organization will include E. M. Rhoads, president and treasurer; B. W. Frederick, vice president; Grant P. Bechtel, secretary and assistant treasurer; and Daniel G. Burkert, assistant secretary and purchasing agent. Harry R. Trout, for the past 10 years general superintendent of the Sanitary Co of America will be general superintendent of the new plant when it is completed.

Studies Effect on Steel of Manganese

Tests made to determine the effect of manganese on steel, by the United States bureau of standards, indicate that it has a restraining influence, so that the pearlite or carbon-bearing constituent of steel, even after annealing, exists in a fine grained condition if considerable manganese is present. The report of the bureau published in scientific paper No. 464 says that high manganese steel resembles in structure the condition which usually obtains in similar steels of low manganese content after rapid cooling, for example, air cooling, and the mechanical qualities of two such steels are quite similar.

The foundry of the Hill Clutch Co., at Breakwater and W. 58th streets, Cleveland, was reopened Jan. 15 as the result of improved business conditions. For several months the company's castings have been secured from outside sources.

Study Pouring Temperatures

Outline of Heat Loss of Iron as It Flows from the Cupola to the Mixing Ladle and Is Transferred to Pouring Ladles—Quick Pouring Essential for Small Steel Castings

BY S. J. FELTON

POURING temperatures have received considerable attention from nonferrous foundrymen for many years. However, in the gray iron foundry, this factor has not been given much attention until recently, except from a standpoint of preventing miss-run castings. One of the phases influencing pouring temperatures is the heat losses in the handling of the molten metal. Elliott gives the following data on heat losses.

"Referring again to our records, we find that the losses given in the following paragraph are fair averages, although it must be clearly understood that the loss of temperature for any of the outlined conditions varies widely under the influence of such variables as volume of the molten stream, size of ladle, temperature of ladle, lapse of time, etc.

"Iron flowing down a 4-foot cupola spout loses about 25 degrees Fahr. There is an average difference of 70 degrees between the stream of iron flowing into a 5000-pound reservoir ladle located at the cupola, and the stream flowing from it. If the iron be poured from ladle to ladle, generally to successively smaller ones, the temperature loss for each transfer is from 70 to 100 degrees. The first mold from a 1000-pound ladle, filled directly at the cupola, is poured at an average of 100 degrees below the temperature of the iron emerging from the cupola, while the last mold is poured after a loss of 200 degrees. If there was an intermediate transfer from ladle to ladle, the maximum loss represented in the pouring of the last mold may be as much as 300 degrees."

These results, supplemented by some records obtained by the writer are shown graphically in Fig. 1. Heavy work is not considered here because such work is generally poured without

The author is instructor of metallurgy and mechanics, the Ohio Mechanics institute, Cincinnati.

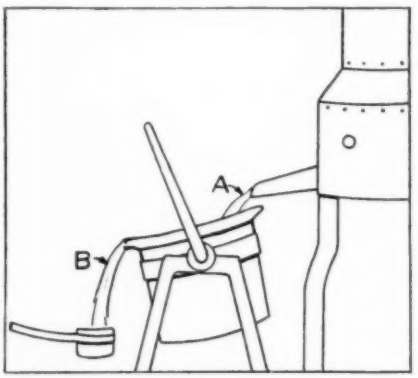


FIG. 2—A CONSIDERABLE DROP IN TEMPERATURE IS FOUND BETWEEN *A* AND *B*

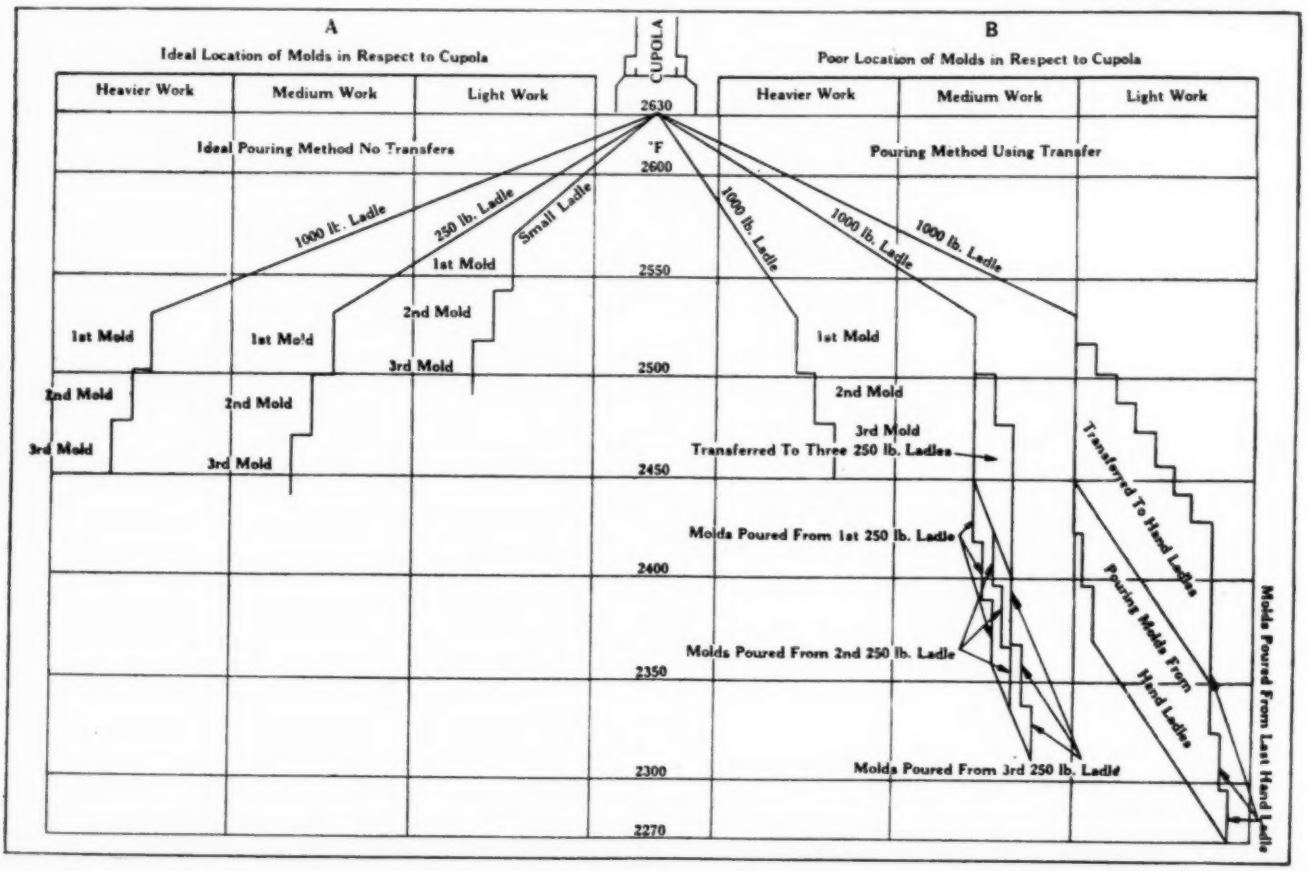


FIG. 1—GRAPHIC ILLUSTRATION OF TEMPERATURE DROP IN MOLTEN CAST IRON USING DIFFERENT POURING METHODS AND ARRANGEMENT OF MOLDS

excessive heat losses in the handling of the metal. The horizontal space on the chart simply represents time and distance, and is not drawn to scale. Although the line representing a 1000-pound ladle, as drawn, indicates a constant radiation lost from the cupola to the first mold poured, the time and agitation in filling the ladle causes a drop in temperature (probably about 70 degrees) so that the loss in transit is a small percentage of the 100 degrees drop shown. The agitation of the metal and the large surface exposed incident to pouring a mold causes a certain drop in temperature of the metal in the ladle as shown in the figure. When metal is transferred to 250-pound ladles or 40-pound hand ladles, there is an instantaneous loss of about 100 degrees which means low pouring temperatures. If metal is transferred to hand ladles successively from a 1000-pound ladle, the temperature of the metal entering each hand ladle becomes lower and lower, a result due to the continual drop in temperature of the metal in the original 1000-pound ladle. Although small castings need a higher pouring temperature than large castings, this transfer method of pouring is used in many foundries. No optical pyrometer is needed to note the enormous temperature difference between the iron from the cupola and the iron entering the molds, when this method of pouring is used. It might be stated that all temperatures given in this paper were taken with an improved type of optical pyrometer, of the disappearing filament type, giving accurate temperatures of molten metal.

Cupola Centrally Located

The ideal layout of a foundry, as far as pouring temperatures are concerned, is the placement of the cupola in the direct center of the molding floors with the light work adjacent to the cupola and the heavy work farthest away. As the use of hand ladles or shanks for catching metal directly at the stack is dangerous, it is more feasible to use an overhead pouring system with small ladles for light work, and a double, tilting cupola spout. The only drawback to this method is the fact that the analysis of the metal is likely to vary due to lack of mixing. However, if a fairly large reservoir of metal is kept in the hearth, this variation should not be prohibitive. It is sometimes argued that in locating light work farthest away from the cupola, temperature drops can be avoided by using quick means of transportation of metal to the floors. However, transportation of metal any great distance necessitates the metal carried each trip being of such quantity that a transfer to small ladles is inevitable for pouring small work. In this transfer the metal suffers a considerable drop in temperature as before mentioned.

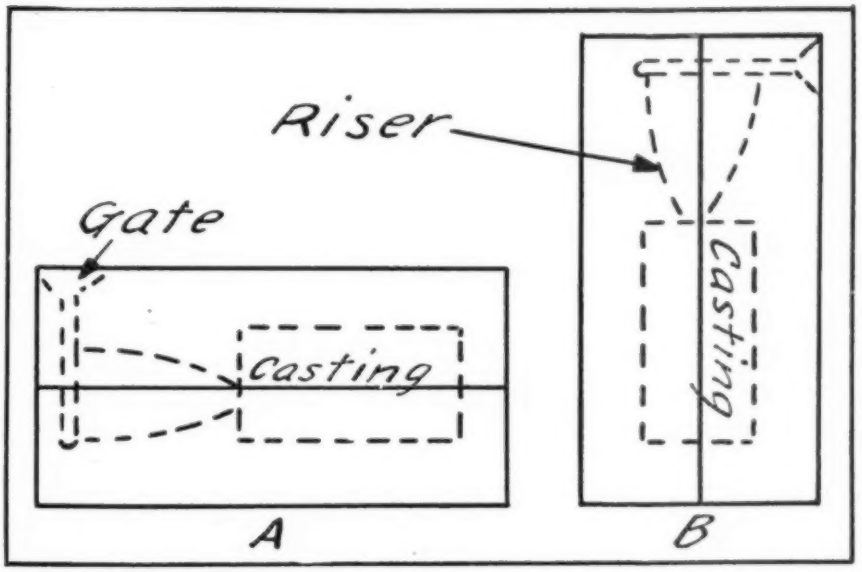


FIG. 3—A MOLD POURED AS INDICATED AT *A*, AND THEN SET UP AS IN *B* WOULD HAVE HOT METAL IN THE RISER

Each mold has one definite pouring range, depending upon size, shape, facing, sand condition, gate area and analysis of metal. If higher temperature metal is used, dirt and slag are likely to enter the mold. As a result of added fluidity of the metal, cutting is likely to take place, or excessive moisture and gases formed may cause blow holes. If poured at too low a temperature, the casting is in danger of missrunning or of not being fed properly. It should be understood that within certain limits the mold could be prepared for high temperature metal by decreasing gate size, using more refractory facing, etc., or it could be prepared for low temperature metal, but with the mold once made a certain pouring temperature should be used to give the best results. Not many years ago, a bench molder had diversified molds on his floor and used a great deal of discretion and judgment in pouring the various molds. In these days of standardized production, a floor is made up of the same molds and the pouring gang makes no distinctions. The transfer method of pouring not only gives low temperature metal for the light work, but also causes an excessive pouring range. If cupola trouble should develop, causing a lowering of the tapping temperatures, difficulty will be experienced in pouring the light work. However, with direct pouring methods the tapping temperature could drop to 2480 degrees Fahr. and still insure pouring temperatures which would compare favorably with average practice in which transfers are used when the cupola tapping temperature is 2630 degrees. Most shops are not equipped to pig a large quantity of metal and are forced to pour iron into molds even though it is dead. Some foundries have overcome this difficulty by installing miniature adaptations of pig casting machines. It is much cheaper to pig dead metal than to pour it into molds.

Radiation Loss Great

The pouring temperature, as well as the mechanical aspects should be considered in choosing the size of pouring ladles. There is a limit to the number of molds which can be poured at a satisfactory temperature from a ladle. Small ladles should not be used to transport metal any great distance, as the radiation loss is too great. Foundrymen realize that iron loses temperature in handling, but rarely suspect the quick loss of heat at high temperatures. The writer has checked pyrometer readings with fluidity tests, using an open-sand spiral mold. Metal caught at *A*, Fig 2, ran 56 inches while metal caught at *B* and poured under the same conditions only ran 39 inches. In another test, metal caught at *A* and carried several feet ran 62 inches, while metal caught at *B*, and poured into a fluidity test at the steak, ran 52 inches. I have seen molders, wishing particularly hot metal, catch iron at *B* in a hand ladle and carry it a considerable distance, indicating that they do not realize the difference in temperature between *A* and *B*. Fig. 4 shows a pattern for a convenient form of the spiral fluidity test.

The higher the temperature of metal

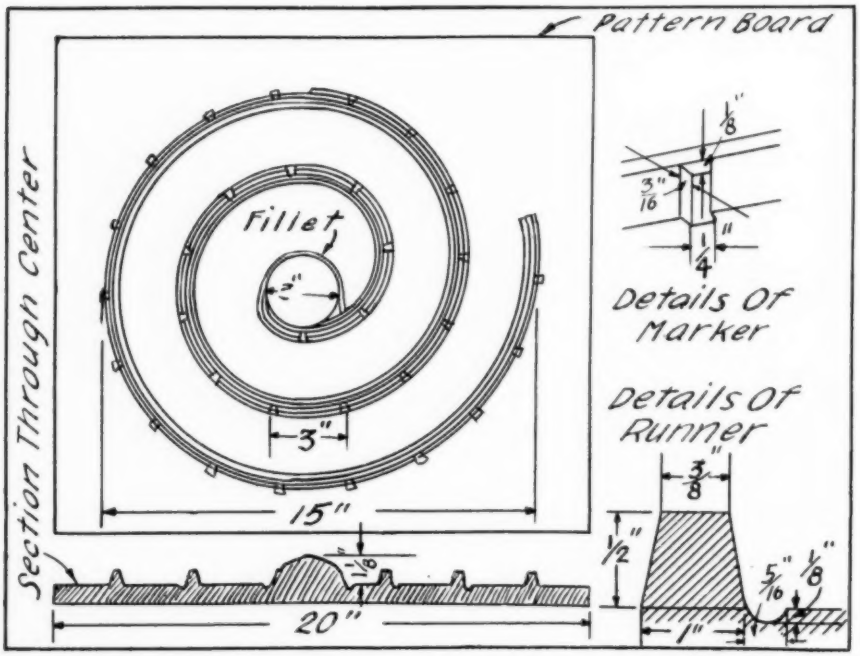


FIG. 4—PATTERN FOR THE FLUIDITY TEST SAMPLE TO BE USED IN LEVEL OPEN-SAND MOLDS

handled, the greater is the temperature *level* above room temperature, and consequently more heat is lost. Steel tapped into shanks from a converter at 2900 degrese Fahr. is poured into molds at about 2790 degrees, representing a loss of 110 degrees. Basic electric steel tapped at 2950 degres into a 1-ton teapot ladle is poured at about 2820 degrees, representing a loss of 130 degrees. Acid electric steel tapped at 3050 degrees into a 2-ton teapot ladle is poured into shanks at 2900 degrees, and from the shanks into molds at about 2790 degrees.

On account of the difficulty of slag separation, basic electric steel is sometimes poured into small molds from a large teapot or bottom-pouring ladle, which is poor practice because of the loss of heat in the ladle due to time required in pouring. Occasionally the molds are stacked, which is generally unsatisfactory because of the temperature drop down the extremely long gate, and because blind risers do not feed properly. It is necessary to gate most steel castings near the bottom, which means that feeding generally takes place from cold metal in the riser. The writer has sometimes wondered whether the plan for certain types of small castings illustrated in Fig. 3 would not give hotter metal in the riser and still allow pouring from the bottom, without presenting too great mechanical difficulties. The mold could be poured in position *A* and immediately tipped up to position *B*.

Malleable iron tapped from an elcetric furnace at 2900 degrees into 100-pound ladles handled by overhead equipment can, by special effort, be poured into molds with about 100 degrees loss.

The future demand for gray-iron castings of uniform hardness and strength will undoubtedly reach the point where the foundry must control some of the many variables in its practice. One of the variables which affect hardness and quality is pouring temperatures. Therefore, in the ideal foundry of the future, it may be possible that a man with an optical pyrometer will be stationed at the cupola, and will have the authority to direct metal to the various floors or pig bed, thus aiding materially in the control of pouring temperatures.

Book Review

The Determination of Sulphur in Iron and Steel; by H. B. Pulsifer; cloth, 160 pages, 6 x 9 inches, published by the Chemical Publishing Co., Easton, Pa., and furnished by THE FOUNDRY, Cleveland, for $2.50 net.

This book has been assembled with the idea of permitting the work of making determinations more intelligently and more thoroughly, using the attainments of the past as a starting point for new developments. A part of the past work is repeated, because much of it was unknown; a part being practically hidden in the pages of old journals and foreign publications.

The book is divided into five sections, the first dealing with the sulphides found in ferrous materials, discussing the sulphur compounds and solutions present in iron and steel, the manner in which the sulphur compounds are crystallized and segregated upon solidification of the ferrous materials, and a discussion on the sampling and grinding of the material in preparation for the analysis. The second part calls attention to the eight methods for determining sulphur, as well as presenting the methods for liberating and measuring the element. An outline of the four methods of analysis together with notes on each method also is included in the second part. The third section indicates the results to be obtained from the analysis.

Since chemical determinations vary greatly, a section of this book is devoted to a discussion of the precision of the results from these analyses. The bibliography contains reference articles directly related to the subject. This part of the book is complete, giving references on the works of men dating from 1797 to 1921. Numerical analytical data of importance in the articles referred to also have been included.

Figures for Nonferrous Metals Show Loss

Decrease in activity of establishments engaged in the manufacture of brass, bronze, copper and allied metal products during the year 1921 as compared with 1919 is shown in a report of the U. S. bureau of mines. The total value of products reported for 1921 amounted to $214,612,000, compared with $482,313,000 for 1919, a decrease of 55 per cent.

To Specialize on Monel Metal Castings

The Alloys Foundry Co., 3334 West Thirty-first street, Chicago, has been incorporated to produce monel and bronze castings. Temporary officers have been named. S. W. Booth Jr., is president, Allen Erikson vice president, and C. B. Carter secretary-treasurer. This company is specializing on monel metal work and equipment to handle it is being installed.

Incorporates Foundry

The Alloys Foundry Co., 3334 W. Thirty-first street, Chicago, has been incorporated to produce monel metal and bronze castings. Temporary officers have been named. S. W. Booth, Jr., is president; Allen Erikson, vice president, and C. B. Carter, secretary-treasurer.

Installing Conveyors

The Ferro Machine & Foundry Co., Cleveland, now is installing a new conveyor system of roller design which will raise its productive capacity from 150 to 300 tons daily without extending the floor area.

Heats Patterns Electrically

Claim Is Advanced That Electric Heaters Have Numerous Advantages Over Gas and Oil Heaters and the Cost Is Favorable in Comparison with Other Methods

BY C. A. CREMER

TWO methods have been made available whereby sand may be prevented from adhering to metal patterns; one is to dust a parting compound over the surface and the other is to heat the pattern and thus prevent condensation of moisture from the sand. Where a parting compound is employed it must be applied frequently. This takes time and in addition it may be done carelessly so that the entire pattern is not covered. This feature is particularly noticeable in the case of intricate patterns or patterns presenting surfaces perpendicular to the plane of the pattern plate.

Proper heating of the pattern insures that the entire surface is in a condition to prevent the sand from sticking and also saves the time required for applying any compound.

The most common methods of heating metal patterns are by means of a gas flame or a kerosene torch. The gas flame is more readily applicable to stationary molding machines, but cannot conveniently be used for portable molding machines, which are moved along the foundry floor as the making of molds progresses. In such cases the kerosene torch, or a tin can filled with sand on which kerosene has been poured, is more frequently used.

Usual Methods

Disadvantage of such crude heating methods surely must be apparent to any one who has had experience with them. The usual method is to maintain a gas flame within the frame work of the machine in the space under the pattern plate. It is difficult to keep the flame low enough so that the pattern will not be overheated. Furthermore, the heat from a gas flame is localized, whereas what is wanted is a uniformly distributed heat so that all parts of the pattern will be equally heated. To overcome these difficulties with low flame and localized heat, it is customary to burn a larger flame than is actually required to produce the necessary heat for the pattern and to locate that flame at a greater distance from the pattern plate. This, of course, is an inefficient arrangement since a large part of the heat is wasted. It has an added disadvantage in that the gas fumes are unpleasant for the workmen and in the summer time the heat is objectionable. Also with this method of heating variable gas pressure necessitates frequent attention, and in some sections of the country where gas is scarce in cold weather, there may be no gas pressure at times when the use of heat is most necessary.

Paper presented at the Rochester convention of the American Foundrymen's association.

Object To Torches

The objections to the use of kerosene torches or tin cans filled with kerosene saturated sand—said by some who have used them to be better than torches—must be even more obvious than the objection to gas flames. Aside from all difficulties with the patterns being too hot or too cold, necessity for cleaning and refilling the torches, general inconvenience, messiness, and crudity of the method, constant emission of evil smelling fumes right into the faces of the men working over the molds have furnished sufficient reason in at least one case, for the manager of the plant to apply a more modern method of heating the patterns.

The manager of the West Newton, Pa., plant of the United States Radiator Corp. conceived the idea of applying electric heaters to the patterns, and made preliminary experiments with heating elements from electric sad irons. The shape of these elements prevented their most efficient application to the pattern and they did not stand up well, but the result indicated that electric heating of metal patterns was practicable.

While in search of more suitable heating elements the manager heard of the steelclad type of heater. Two of these were secured and applied to the patterns and the results were so satisfactory that now about 15 patterns are equipped with similar electric heaters.

Fig. 1 shows the general shape of the pattern with its supporting carriage. The power is supplied from an ordinary lamp socket through a flexible cord which is attached to the pattern carriage. In moderately cold weather the heat is used intermittently as the need for it appears, but in extremely cold weather, the heat is left on continuously while the pattern is in use. The capacity of the heaters is 600 watts at 110 volts, and the temperature to which the patterns are heated is approximately 90 or 100 degrees Fahr.

Fig. 2 shows how the heaters are applied. Standard steelclad heaters of the narrow type in the form of a long flat strip approximately 20 inches long, 1⅛ inches wide and ⅛ inch thick are laid in grooves cut in the face of a cast iron plate which forms the top of the carriage. The heater terminals project downward through holes drilled through this plate and are wired to a socket on the side of the carriage. The upper surfaces of the heaters, perfectly flat, are flush with the upper surface of the plate, so that when the pattern plate is laid on the top of the carriage the heaters are in contact with it. With the pattern plate in place, and fastened with suitable bolts or screws, the assembly is similar to the construction of a modern electric iron—the heating elements being firmly clamped between two metal plates so that the heat from the heating elements will be transmitted by conduction to the working surface. This enables the heaters to operate at a relatively low temperature, and makes the surface of the pattern quickly responsive to the application of heat.

Mount Electric Heaters

Some of these pattern carriages have been equipped with electric heaters mounted in the space below the pattern plate, but not in contact with it, so that the heat is transmitted to the plate by radiation instead of conduction. This method is not so efficient in utilization of the heat and results in slightly greater power consumption and slower heating, but is otherwise satisfactory. It is a cheaper method of installing the heaters and in some cases it may be also the most practicable method to use.

The manager of the plant where these electrically heated patterns are in daily use has reported that the use of electric heat has been cheaper than the use of the kerosene torches, be-

FIG. 1—SHOWING THE METHOD OF ATTACHING HEATER

sides being more satisfory in other ways, particularly with respect to the absence of obnoxious smoke and fumes.

At about the same time that electric heaters were being applied to the radiator patterns, another manufacturer installed electric heaters of the same type in a molding machine. As in the case of the radiator patterns the method of applying the heaters consisted essentially in arranging and supporting them so that they would be in contact with the under side of the pattern plate below the thickest part of the pattern. The heaters were not attached to the pattern plate, but were supported on angles attached to the frame of the machine, and, therefore, their presence did not interfere with the changing of the pattern whenever required.

The heaters are of the steelclad type which consist of slotted ribbon heating elements of high resistance, heat resisting alloy, insulated with a mica envelope and the whole inclosed with a sheet steel casing applied under hydraulic pressure of two tons per square inch. At each end of the heater the steel casing is extended to form a mounting lug and has two holes punched in it for the fastening screws. The terminals are at one end of the heater and are protected with a substantial metal cover.

Fig. 3 shows the pattern plate removed to display the heaters mounted on the angles in the frame of the machine. To prevent loss of heat by radiation downward from the heaters an asbestos heat insulating plate was placed just below the heaters.

The presence of the heaters did not in any way interfere with the usual

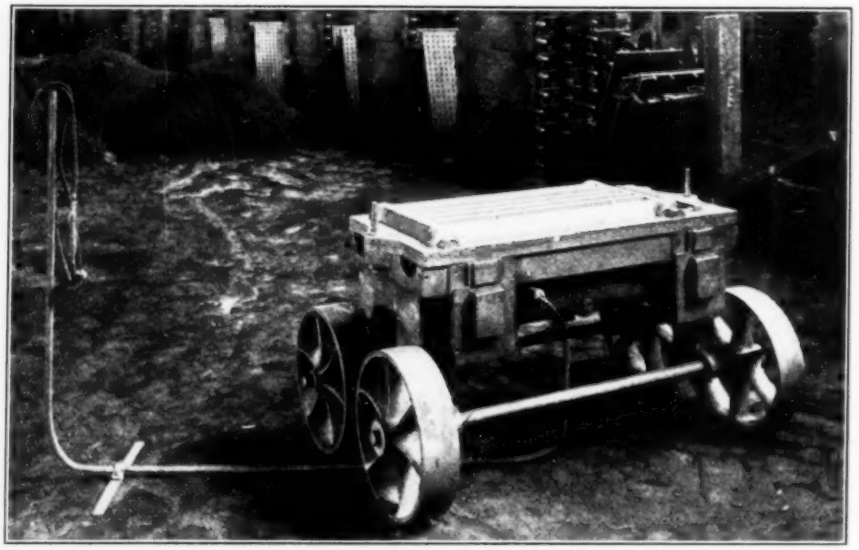


FIG. 3—FLAT HEATER ELEMENTS ATTACHED TO PATTERN PLATE

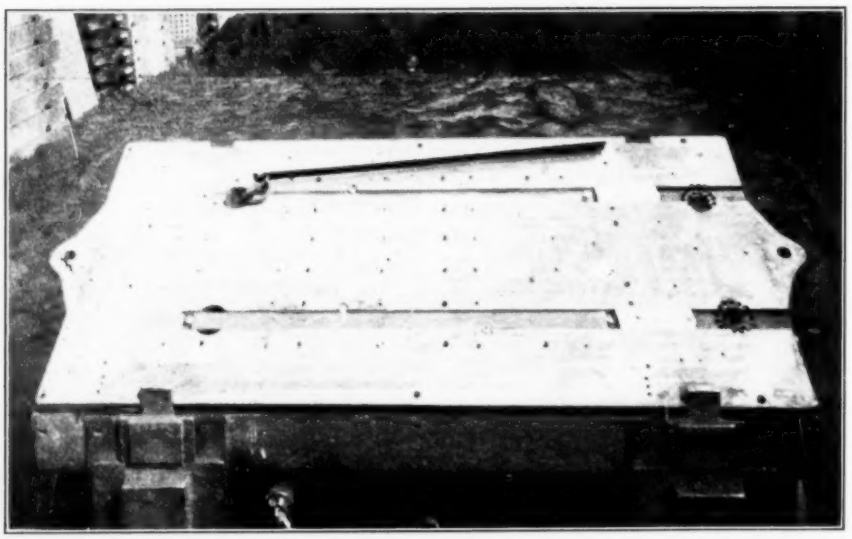


FIG. 2—METHOD OF ATTACHING HEATER TO ORDINARY PATTERN PLATES

operation of the machine or the functioning of the mechanical vibrator, and the entire installation was made without any modification of the machine other than the drilling and tapping of small holes for attaching the mounting angles.

The machine takes a pattern plate 16 x 11 x 2 inches. The two heaters applied were each 13 inches long, 2¼ inches wide, ¼ inch thick, and had a total rating of 300 watts at 110 volts. Connection to the source of power was made by means of a flexible cord and an ordinary separable attachment plug.

The simplicity, convenience and cleanliness of this method of heating metal patterns must be obvious. The cost of operation varies with different conditions, such as the size of the pat-

terns, number of molds made per hour and the price paid for power. But the cost of operation is a relatively small item in any case and quite inconsiderable in comparison with the advantages of the method. As a matter of actual experience, in cases of which we have record, the electric method of heating patterns is really cheaper than the metals previously used.

It might be interesting to note that in the manufacture of firebrick and bathroom tiles, there is difficulty with the material sticking to the dies on the press plungers, just as the sand has a tendency to stick to the metal patterns. The remedy for this difficulty is the application of heat to the dies. Steam heat has been used but has many drawbacks, and lately electric heat has been successfully applied. The type of heater and the method of applying it is similar to that described for the metal patterns.

Report on Molding Sand Production

Molding sand produced and sold in the United States in 1921 aggregated 1,906,977 net tons valued at $2,451,966, compared with 5,128,075 tons valued at $7,504,759 in 1920, the federal geological survey reports. The average received at the pit mouth in 1921 was $1.29 per ton, against $1.46 in 1920. Named in order of their output, Ohio, Illinois, New York, Pennsylvania, New Jersey and Indiana accounted for 83 per cent of the production in 1921.

Steel Castings Output Large in 1922

Sales of commercial steel castings in 1922 were almost three times as large as in 1921, and were at almost the same level as in the year 1920, according to an announcement by the department of commerce from data compiled by the bureau of census in co-operation with the Steel Founders' society, from 65 companies comprising, two-thirds of the commercial castings capacity of the United States.

Commercial castings booked in 1922 by these companies, with a capacity devoted to commercial work of 1,162,800 tons a year, totaled 795,059 tons as against 287,674 tons in 1921, and 793,305 tons in 1920. The 1922 bookings were equivalent to 68.4 per cent of shop capacity, as against 24.7 per cent in 1921, and 68.2 per cent in 1920.

Railway specialties slightly exceeded miscellaneous castings in the 1922 sales, while in 1920 and 1921 the bookings of miscellaneous castings were about 50 per cent greater than railway specialties. Railway specialties were booked at 86.9 per cent of shop capacity in 1922 and miscellaneous sales at 56.3 per cent.

The largest monthly bookings of steel castings since the end of 1919 occurred in March, 1920, when 110,282 tons were booked, or 113.8 per cent of the shop capacity of the reporting firms. Thereafter an almost uninterrupted decline in bookings took place until the minimum of 15,785 tons was reached in July, 1921, at 16.3 per cent of shop capacity.

Except for a slump in December, 1921, a gradual increase in bookings ensued until June, 1922, and, after two low months, reached in September, the highest mark since March, 1920, with total bookings of 97,919 tons, or 101.1 per cent of shop capacity. Declines occurred in October and November, but December bookings were over 13 per cent larger than the November sales, with increases in both railway specialties and miscellaneous castings. December bookings equaled 71.1 per cent of shop capacity.

Introduces Jointless Furnace Lining

Recognizing the tendency of firebrick in a brass furnace lining to crack at the corners when exposed to the intense heat of the furnace, and so weaken the brick, the Jointless Fire Brick Co., Chicago, has developed a new lining for brass furnaces. This lining is jointless, being in one piece. Also it is plastic so that it can be pounded and molded into place by the use of a mallet and trowel. When heat is applied the lining is vitrified and is said to withstand a temperature of 3100 degrees Fahr.

Plant Gets New Name

The Sampson Tractor division of the General Motors Corp., with plants located at Zanesville and Waukesha, Wis., has passed out of existance so far as the name is concerned. The Waukesha plant, which is a 100-molder malleable foundry, will be known as the Waukesha division of the General Motors Corp., operated by A. R. Glancy Inc.

Book Review

Oxy-Acetylene Welding and Cutting; by P. F. Willis, cloth, 254 pages 4 x 6¼ inches, published by the Norman W. Henley Publishing Co., New York and furnished by THE FOUNDRY, Cleveland, for $1.50 net.

This is the sixth edition of this book which has been revised and enlarged by the addition of new matter and some engravings. The volume is intended to instruct in the care of apparatus, welding of all metals and alloys, care of expansion and contraction, soldering aluminum, repairing scored cylinders, etc. It should be of use to manufacturers, metal workers, garage men, railroad operators, blacksmiths, etc.

The three types of welding namely acetylene, oxygen and electric welding are explained as well as the various types of apparatus used in the execution of each method. A discussion of the methods and tools necessary in the preparation of the metal for weldings as well as a description of the various metals that are adopted to weldings is included. Other chapters deal with welding of sheet metal and pipe, boiler welding, welding of various pieces and welding symbols.

Buys Collinwood Plant

Max Greenhut, president and treasurer of the L. N. & N. Foundry Co., Cleveland, has purchased the plant and assets of the Collinwood Foundry & Machinery Co. from F. J. Pekoc Jr., receiver, for $52,000. The purchase includes the machinery and tools of the Collinwood company.

Organizes New Company

John Kalk, formerly with Dunham Co., Berea, O., and later with the Muskegon Castings Co., and the Eagle Foundry Co., both of Muskegon, Mich., holding in each case the position of foundry superintendent, has organized the Montague Castings Co., Montague, Mich., which will operate the plant of the former Montague Iron Works.

Bell Output Decreases

The United States department of commerce announces that the value of products in establishments engaged primarily in the manufacture of bells amounted to $645,000 in 1921, as compared with $951,000 in 1919, and $970,000 in 1914. Of the nine firms reporting in 1921, three were located in Connecticut; two each in Missouri and New York, and one each in Illinois and Ohio.

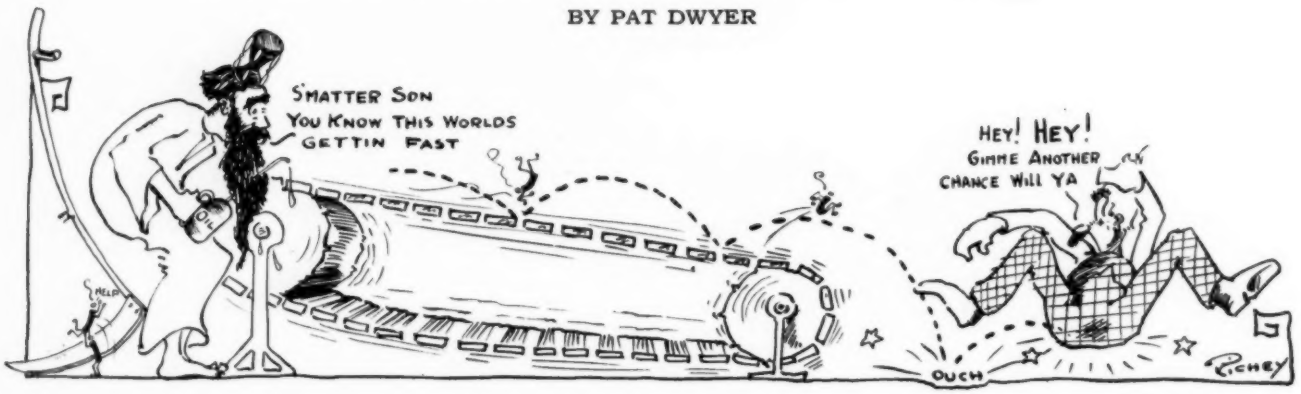
Joins Coke Sales Force

Olin R. Kuhn, who formerly was identified with the raw materials department of the Midvale Steel & Ordnance Co., Philadelphia, and prior to that with the Jones & Laughlin Steel Corp., at Pittsburgh, now is affiliated with the foundry coke sales force of the Emmons Coal Mining Co., Union Arcade building, Pittsburgh.

The Chicago office of the Northern Engineering Works, Detroit, has been removed to 53 W. Jackson Blvd., and M. H. Haeger, of the Abell-Howe Co., is in charge.

Bill On Repairing Broken Castings--III

BY PAT DWYER



EVERY normal man at one time or another in his career derives a certain measure of melancholy consolation from the reflection that if he had his life to live over again he would improve vastly on the program. The same probably is true of the ladies; but as a man of discretion and some slight experience I refuse to be drawn into a discussion of that phase of the subject. What I have in mind particularly at the present time is the avalanche of trouble a man precipitates on his head by talking too freely. These figurative chickens mentioned in the proverb have a wonderful and uncanny habit of coming home to roost. In my sublime ignorance of the future it is possible that at one time I may have mentioned in the presence of a certain young lady who is sufficiently intimate to call me, Paw, to my face, that I had some slight acquaintance with Latin in my school days. I should have told her that I had been exposed to its pernicious influence, but that it did not take.

Apparently she thinks that although the fruit and the blossom may have disappeared, a few of the roots still may linger in my mind. On that assumption she consulted me the other night while preparing one of her lessons for the following day.

I told her that I appreciated the implied compliment, her faith was beautiful and touching; but as a source of knowledge I regretfully felt that I was in the same class as the gentleman who invented Latin. To the best of my knowledge and belief he has been quite dead for some time. Bill dropped in about this time and with the familiarity of old acquaintance proceeded to stick his long oar into the conversation. "I don't know much about this Latin stuff," said he. "I was chased out of school before I had acquired any proficiency in digging after obscure roots or in flirting with elusive declensions and conjugations. After leaving school I was introduced to a shovel in the foundry and the labor involved every morning in digging over a sand heap half a mile long soon drove what little Latin I had absorbed, clear out of my mind. In fact the only memories I retain are a rhyming version of the conjugation of the verb *Amo, Amas;* two colloquial phrases, *cave canem,* beware of the dog and *caveat emptor,* let the purchaser beware. I have learned long ago that the first is, as our friend Solomon says, vanity of vanities; the second has no particular application since I quit the hobo trail; but the third—well, the third presents possibilities. The last time I was over here I was talking about burning-on castings and now I want to tell you about an experience I had along that line at one time where this *caveat emptor* thing came into play.

"I have repaired many castings by the burning-on process at one time or another, but I think I derived more real pleasure in patching the body of a butterfly valve than any other. The circumstances under which the job was undertaken were a little out of the ordinary and the finished appearance of the completed casting was so satisfactory that I experienced that particular glow of craftsman's pride which comes only to a man who has done a creditable piece of work. Furthermore, the operation was somewhat of a gamble and you know how a person feels when he wins a long shot.

"In addition to the foregoing—and this was the most gratifying feature of all—the customer who prided himself on knowing all things said it couldn't be done. He was not a foundryman, but like many other competent men—competent in their own particular line—he considered the foundry relatively unimportant and its methods and processes rather primitive.

"The popular conception of a foundry is a place where the workman buries a *mold* in the sand, pulls it out and then fills the cavity with molten metal. Quite simple and uninteresting, me good man, and quite within the compass of a rather rough, uncouth and unlettered class of workmen. God help us all. Sometimes I am undecided whether to laugh at or pity their ignorance when they refer to the sand as clay and call a shovel a spade.

"One of them on a certain memorable occasion remarked to me naively that he understood perfectly how the lower part of the mold was formed, but really he was at a loss to know how I made the mud stick to the cover. I assured him, gravely, that it was a secret process guarded jealously for many years by members of the molder's union. It was one of the many inside tricks of the trade that was withheld from the apprentice until he had finished serving his time and had been initiated and established as a member in good standing. I didn't know if I was justified in divulging it or not, but I felt that he was a man of discretion and if he promised to keep it strictly under his hat, I would take a chance. I told him that a certain quantity of iron filings from the machine shop was mixed with the facing sand. The iron bars in the cope were heavily magnetized and held the sand in place. He nearly tripped me when he said he had seen wooden boxes used, but I

A LITTLE SECRET PITCHER AND CATCHER STUFF

hastily assured him that if he had examined them closely—a totally improbable contingency—he would have noted that a row of nails projected from the lower edges of all the bars. The nails were magnetized and in addition I was sure he had observed that short iron rods, bent at one end and known technically as gaggers, were adjusted in place all over the exposed surface of the mold. The attraction of cohesion held the gaggers in place when the cover was lifted off the mold and the magnetic attraction held the prepared sand in contact with the gaggers."

"Do you mean to tell me" I said "that you handed that line of bunk to any presumably intelligent person and—to use one of your own expressions—got away with it?"

"Hand it to him?" said Bill. "Sure! Why not? I did more than hand it to him. I made him believe it. I showed him some of the facing sand. I don't know whether or not you ever saw it done, but it is fairly common practice in some foundries to mix iron filings with the facing sand used on the teeth in a gear wheel mold. The iron in the sand acts as a chill in a mild way and produces a much closer grain in the teeth of the casting than if they had been formed in an ordinary sand mold. I took this bird down the gangway to where one of my men was making a gear wheel mold and showed him the facing sand. I picked up a handful and rubbed it on the handle of a shovel and of course the polished surface disclosed the iron particles scattered all over it quite distinctly. Convinced? I should not be surprised to learn that he had prepared a paper on the subject. I have seen papers—voluminous papers—based on slighter proofs. However, I fear we are drifting away from the subject. My intentions are good, but your irrelevant interruptions compel me to detour to an extent that militates against making any kind of time.

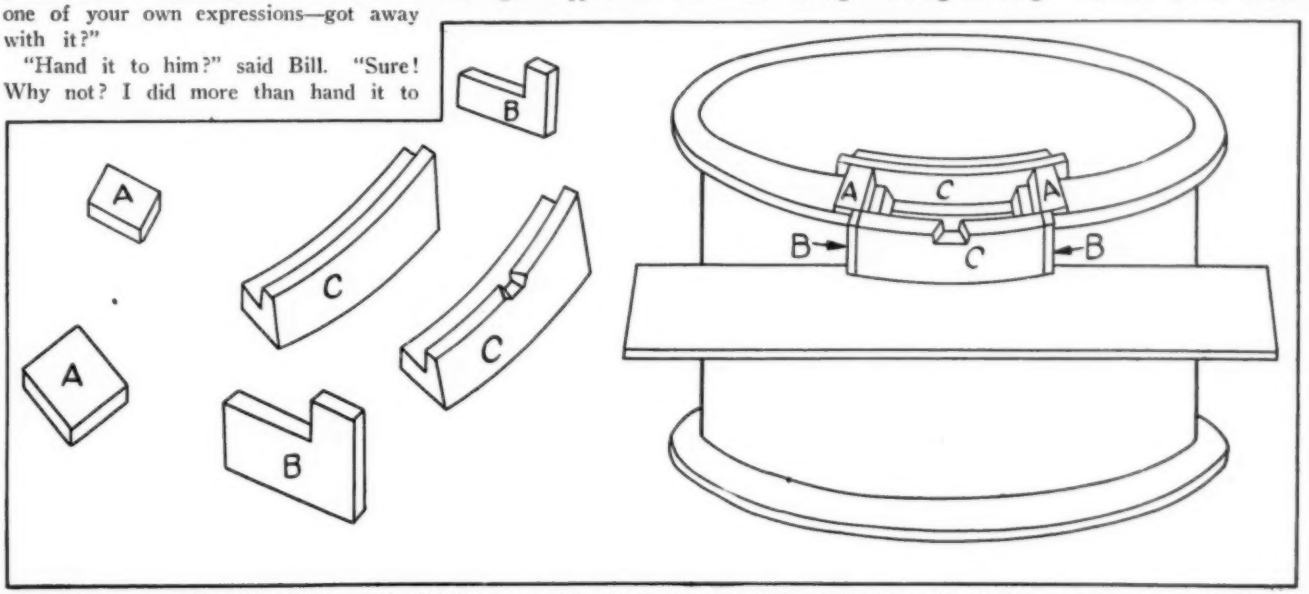
"An outside engineering firm secured a large contract for erecting extensive additions to a steel plant in the town where, at the time, I was connected with one of the local foundries. The firm fabricated a considerable part of the equipment in its own shops and shipped it to the steel plant ready for erection. In addition, with a view to saving time and also freight charges, a fairly sizable tonnage of the castings required was placed with foundries within a hundred mile radius of the plant.

"Our company handled a share of this business and also took care of emergency jobs that arose almost daily during the period of erection. Among the castings shipped in from the foreign plant was a body for a small butterfly valve. It was a plain casting, a short pipe section approximately 30-inch diameter, 30 inches high and flanged at both ends. In some manner the casting slipped out of the slings while it was being unloaded at the point of destination and fell upon a pile of material that was at least as hard and perhaps a little harder than itself. It fell in such a manner that a section of one flange about 6 inches long was broken out, something that to all intents and purposes rendered the casting useless.

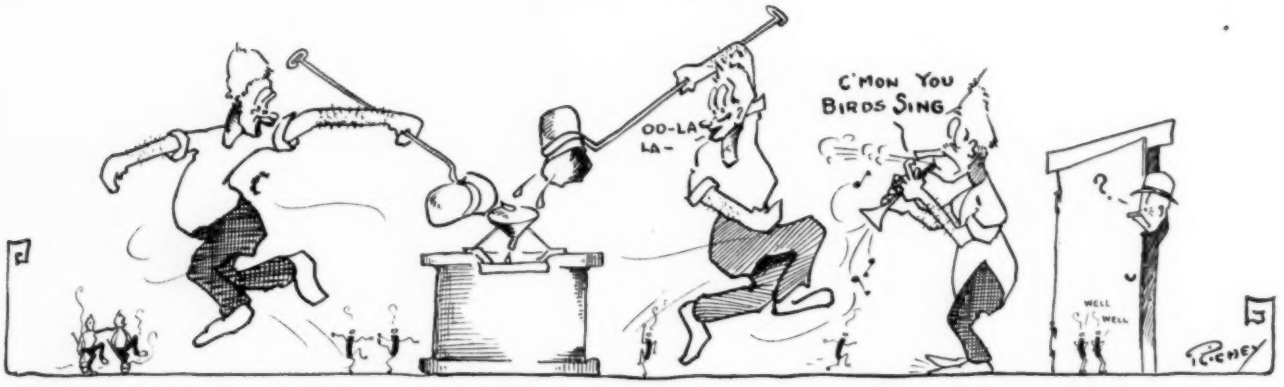
"The casting had been faced on both flanges and drilled for bolt holes and its replacement so far from the company's shops involved a possible delay of several weeks. The erection superintendent called up our little go-getter manager and asked him to quote terms and date of delivery on a new casting. The manager quoted him a price that included the cost of making a pattern and also machine shop expense for facing the flanges and drilling the bolt holes. The lad kicked, as in duty bound, invoked high heaven to witness that the only difference between foundrymen and the James boys was that the James boys collected their toll on horseback. The promise of delivery in three days finally offset his obejctions to the price and he placed the order.

"He shipped the broken casting over to the foundry by truck and when it arrived in the yard the manager directed me to extend myself to the limit. He said that he had allowed himself no leeway in making the promise and he expected me to help him make good. I told him that I would burn a patch on if he wished to do some real speeding on the job, he could do the machine work that night and ship the casting the following morning. He was not a foundryman, but he was a game lad and held a flattering estimate of my ability. He called up the customer and told him that he would deliver the casting in one day instead of at the end of the third day. He said he would do it on the condition that the agreed price was maintained. The customer naturally was curious to learn how he expected to beat that hardest of all handicaps—time—and when the manager intimated that he intended to repair the casting rather than make a new one he laughed at him. He admitted that a passable job could be done on a plain, straight casting, but claimed that if we attempted to burn-on a broken flange the body of the casting would split from top to bottom.

"After hearing the report of the conversation I was more determined than ever to take a chance on the burning-on process. If it failed I knew that I could have an emergency pattern consisting of two band sawed flanges and a set of plain staves, assembled in time to make a casting in the orthodox manner and still keep inside the three day



INDIVIDUAL CORES EMPLOYED ARE SHOWN TO THE LEFT AND THEIR METHOD OF APPLICATION IS SHOWN TO THE RIGHT



REPRODUCTION OF A PAINTNG BY ONE OF THE OLD MASTERS ILLUSTRATING A FAMILIAR FOUNDRY SCENE

limit. The casting arrived in the morning which allowed us ample time to test the burning process with the first iron in the afternoon and if it failed I still would have about two hours to spare in which the patternmaker could prepare a pattern for the following morning.

"From the pattern storage I selected a segmental flange corebox that conformed closely to the circle of the casting and rushed two cores into the oven. The wall of each core was built up an extra 2 inches by hand before it was placed in the oven. Several pieces of slab core selected from the stock pile, were filed to fit between the cores at each end. Perhaps I had better make a sketch of the assembled job and then you can gain a clearer idea of how it appeared before the iron was poured into it."

Instinctively he felt in his vest pocket for the soap stone pencil with which he does all his sketching on the core oven door and then realizing that no core oven door was available in the present instance, he grinned apologetically, replaced the pencil in his pocket and employed an ordinary pencil and a sheet of the young lady's theme paper to produce a sketch approximately like the accompanying illustration. The straight lines wabbled about a bit and the curves were highly irregular, but the general effect was there and that is more than I can say for many more pretentious works of art.

"There y'are" said Bill, holding the thing at arm length and cocking an admiring eye at the monstrosity. "It is not drawn to scale and may be a little out of proportion, in spots, but if your eyes are even in comparative working order you will experience no difficulty in visualizing the method and equipment employed to do that little job.

"I realized that the actual preparation of the mold and the subsequent pouring of the iron so that the patch would stick, only constituted the minor part of the problem. The feature which presented the real obstacle was the immutable law of contraction and expansion which affects all metals when they are heated. To prepare for this contingency I reasoned that if I heated the entire casting to a good red heat the contraction subsequent to pouring molten iron at one point practically would be uniform all over. In the same manner the preheating would expand the casting to its natural limit and therefore the addition of a quantity of molten iron at any one point would not cause it to expand any further.

"Several ideas suggested themselves for heating the casting, but like many other jobs with which I am familiar, I decided that the simplest was the best. I converted the casting into a stove. Two rows of bricks were set up parallel and about 30 inches apart on the foundry floor. Grate bars from the scrap pile were placed on the bricks and the casting was picked up by the crane and lowered onto the improvised grate. A coke fire was built inside the casting and in about half an hour the casting had attained a beautiful red heat. We assembled all the necessary equipment close to the casting and after the blast was put on the cupola we prepared the mold in the manner shown in the illustration.

"The coke was pushed back from the section to be repaired and the entire fire was covered with a few shovelfuls of sand. One segment of the flange core was adjusted on the inside of the ring and a quantity of black sand was rammed behind it to hold it in place. A plain rectangular core plate was supported on two brick piers on the outside and the second flange core was placed on it and packed up against the flange of the casting. A piece of pig iron and a few shovelfuls of sand served to hold it in place. The two end cores and the two pieces of flat core on top then were set and anchored in a similar manner.

"By this time we had a 1000-pound ladle of smoking hot metal ready and the remainder of the operation presented no difficulty. Two men tipped the ladle in such a manner that the stream was directed to all parts of the exposed surface while I felt the same surface with a bent rod until I was certain that it was thoroughly fused. The job required about 500 pounds of metal and the remainder of the metal in the ladle was poured into a convenient mold. The manager was an interested observer and on my assurance that the job apparently was perfect he decided that the machining operation could be deferred until the following day. I heartily concurred in this decision since by that arrangement I could leave the fire on the inside until it had burned itself out. The sand was scraped off the top of the fire and additional coke was provided so that the casting would be maintained at a red heat for several hours.

"On the following day I tapped the patch all over with a hammer and failing to detect any suspicious sound sent the casting to the machine shop with a clear concience. About noon I was invited over to have a look at the job. The machinist had removed all the superfluous metal and then had taken a light finishing cut all over the surface and if it had not been for the absence of two bolt holes I should have experienced considerable difficulty in detecting the patched section of the flange. The holes afterward were drilled and the repaired casting was shipped back the day after it had been delivered to the foundry."

"How about the customer?" I said "Was he convinced?"

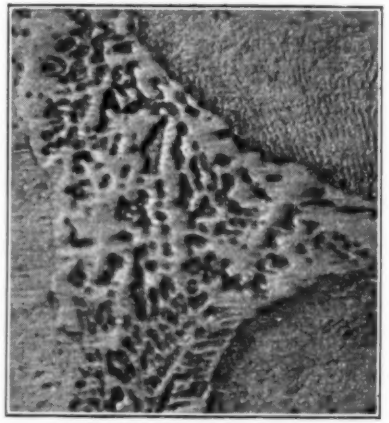
"Convinced?" said Bill. "Not he. When he saw the newly machined flange he smiled in a superior manner. 'I know you would have to make a new casting.' he said 'That burning-on stuff is all bunk.' On the principle that the customer always is right, my manager made no effort to set him right. He billed him for a new casting, including the price of a pattern and machine work and the lad cheerfully O.K.'d it. Har, har, I'll say we *caveat emptored* that bird alright."

J. S. Davidson is in charge of the St. Louis office of the Northern Engineering Works, Detroit. The St. Louis branch is at 606 Pontiac building.

MICROSCOPY OF CAST IRON

(*Continued from Data Sheet No.* 464)

The illustration at the right shows how relief polishing eats out the softer components of steadite, leaving the harder parts in relief.

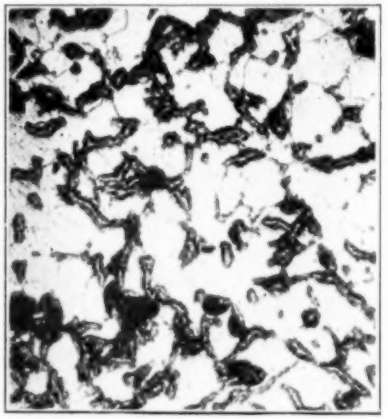


The illustration at the left shows an iron largely perlitic. The thumb print, or laminar structure is pearlite, the black flakes graphite, and the white dentrite is steadite. Pearlite is the strongest compound of ordinary gray iron. It has the same structure a 0.90 per cent carbon annealed steel. The sample was etched with picric acid and is magnified 600 diameters. Considering the high magnification the graphite flakes are small.

(*Continued on Data Sheet No.* 466)

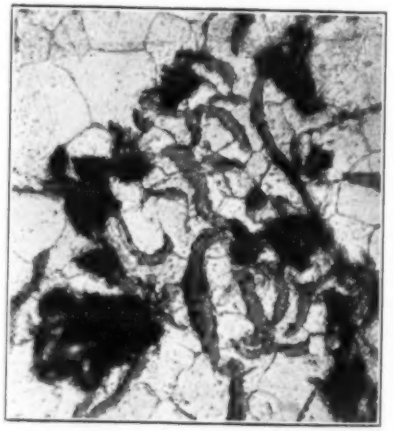
MICROSCOPY OF CAST IRON

(*Continued from Data Sheet No.* 465)



The illustrations in this section show ferrite in gray iron. The polygonal grains are ferrite, which is pure iron. This with cementite, the carbide of iron, forms pearlite. Ferrite is not as strong as pearlite but is more ductile.

In gray iron practice much ferrite generally indicates a weak iron. The black and gray flakes in the illustrations are graphite and temper carbon. The illustration above is magnified 100 diameters and that below at 300 diameters.



(*Continued on Data Sheet No.* 467)

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

Organize for Taking Inventory

Physical Inventories Unnecessary Except for Checking Accuracy of Accounting Procedure—Temporary Organization of Department Heads Should Be Effected and Counting and Checking Started in Advance

BY O. C. KIEHNE

PRIOR to general appreciation of cost systems, when accounting procedure consisted of clearing practically all operating and trading transactions through the merchandise account; and the manager of a company was satisfied to wait 12 months for information as to the profits or losses incurred during a year's activity, the practice of taking inventories was to close down the plant for several weeks during the season when business usually slackened. This being the end of the calender year, was the time when salesmen would be called in for the holiday season and the salaried personnel notified that an inventory would be taken, starting the next morning.

Responsibility Passed

During those days inventories were looked upon as a necessary evil to be disposed of along lines of least resistance. Responsibility was passed from one person to another until a few foremen, clerks and office boys were the only ones left to assume it. Little or no instructions were given or preparation made from either an accounting or a production point of view. It could not be easily proved whether all items were salable or whether the valuations placed upon them represented any relation to current prices, as in many instances this important function was left to a file clerk, whose only responsibility was to search the files of the organization for an invoice corresponding to the material, and, of course, such invoices may not have been the latest ones. If any ommissions or duplications occurred in the taking of the inventory, the discrepancy often was undetected, and in many cases where material was received immediately prior to the closing of the period and the invoice dating did not require payment for 30 or 60 days, hence the inclusion of such items simply showed up as additional profit. Purchases were not charged until cash was credited.

Materials usually were stored in vacant places, with little consideration given to convenience in handling or protection against loss by deterioration or otherwise, and yet if a stray penny remained unprotected in the cashier's office, the offense was sufficient to warrant his dismissal. Does it not seem strange that even today a dollar in cash appears so vastly different from a dollar represented by material for which cash was paid, and that in many cases if the accounting for material was half as rigid as accounting for the petty cash, many a sheriff would have fewer sales to his credit?

However, we have progressed from bookkeeping to accounting, and by accounting we mean all that the word implies. Physical inventories need not be taken under present accounting procedure for the sole purpose of determining the profit or loss of the period, or to effect an annual renovation of the factory and storerooms. They are taken to prove the results as shown by the general books of account, and it is advisable to take a physical inventory at least annually for the purpose of determining the accuracy of the accounting procedure. This essential is not only required by the management of a company, but under present day practices of industrial expansion, credit extension and federal income requirements, it is absolutely essential that physical inventories be taken. The comments of an audit report and the inventory certification blank required in connection with income tax returns, positively certifies the inventory and explicitly states the conditions under which the same has been taken and proved correct.

When speaking of physical inventories we could of course interpret this to include all items of invested values of properties, but under present day methods, such items of permanent investment as machinery equipment, tools, fixtures, etc., are covered, but by scientifically making allowance for the portion lost through depreciation and obsolescence. A physical check is not often required, except in cases of revaluation or special appraisals. Therefore, consideration will be given only to that part usually known as the merchandise inventory. This consists of all raw materials and parts that are used in the manufacture of the product, and such miscellaneous items of operating supplies as are carried under general stores.

Several distinct points should be considered in connection with taking an inventory. These are as follows and are taken up consecutively: 1. Advance planning and preparation; 2. physical count, check and summary; 3. valuation.

Under advance planning and preparation, many irregularities that otherwise develop at the eleventh hour can be anticipated and disposed of prior to the time of physical count and check. If it is desired to take the inventory with a view of minimizing the closing of the plant, each person entrusted with any part of the work must be instructed properly previously to the closing period. It has been found unsatisfactory to place the responsibility for planning and supervising the work upon one person, and in most plants it is now standard practice to create a temporary organization composed of department heads for planning the physical preparation of the plan and later supervising and directing the execution of the work. Such an organization should include such persons as the general manager as chairman, auditor, chief engineer, superintendent, production control supervisor, cost accountant, general storekeeper, chief inspector and purchasing agent.

Details for Investigation

Some of the details of preliminary investigations and planning of requirements that would be disposed of by such an organization are as follows:

1. To make a general survey of all items of stock material to determine whether they are in good condition and salable and order disposition of such defective, obsolete or deteriorated materials as may be disclosed by such an investigation.

2. To see that all materials are located, are properly symbolized, classified and stored and are supported by proper records.

3. To instruct all factory operating departments to dispose of any strayed or defective material, and to see that all materials in the plant are sup-

From a paper prepared for the Industrial Cost association. The author is supervisor of cost and production control, Van Dorn Electric Tool Co., Cleveland.

ported by open production or betterment orders.

4. To advise the production control department to retard additional releases of work in progress immediately prior to inventory and to complete as many jobs as possible before the closing of the period.

5. To pass upon the basis for valuation and have a pricing system prepared, whereby all inventory items can be priced and extended for valuation immediately after the physical count and check; and to request all necessary assistance from various departments to prepare price schedules for different classes of the inventory.

6. To issue detailed instructions for taking the inventory defining the responsibility and part that each person is to assume, to thoroughly familiarize them as to methods and procedure and the proper persons from whom to seek advice as well as to whom to report irregularities.

7. To prepare proper classification and arrangement of inventory items in accordance with the purpose for which the same will be used.

If the advance planning and preparation is thorough, and if the organization has been properly instructed, a thousand and one questions have been answered; and the personnel can spend its efforts on the positive work of counting and listing instead of looking for a place where they may be of service.

Physical Account Taken Early

The next phase for consideration is the physical work of counting and checking the inventory. In organizations where the product is of large variety, and where the individual parts and classes of material may be in the thousands, it would be a physical impossibility to close the plant and expect an accurate count, check, listing and description of all items to be completed and vouched for as to accuracy the succeeding day, regardless of how large a force is detailed to the work. However, it is possible to accomplish this result by providing a method whereby the counting and checking can be started several weeks in advance of the closing period, and which automatically adjusts itself to the balance on hand as of the close of the period by accounting for the movements of stock during the interim.

Assuming that all stock on hand is supported by corresponding stores records, a balance verification can be made as of the date of counting and checking the stock. After counting and checking each item, the same is recorded immediately by the issuance of a set of serially numbered inventory tags in duplicate. The original describes the material, the location and the quantity inventoried, and is designed to standard dimensions for vertical filing to be used for reference.

The duplicate gives the same information as to description and initial count as the original, but in addition is provided with extra columns for recording any receipts or disbursements that may develop between the time of original count and the closing of the period. A small portion bearing the corresponding serial number is perforated so that it may be detatched. This duplicate tag is secured to the material of which a record has been made, and the original sent to the stores department as a check against the records as of the date of issuance. The duplicate tag remains with the material until the close of the period, at which time an investigation committee is requested to check every bin or lot of material to see that the same is supported by a tag, and upon favorable report, a release order is issued at which time the body of the tag is detatched and the stub left attached for indentification purposes in case a recheck is required. These tags are then checked against the stock records, and in case of variations, the receipts and disbursements are checked between the stock records as shown by the inventory tag all differences being reconciled by adjustment after a recount. It is at the time of recount that the stub left attached to the material is valuable.

The remainder of the inventory work consisting of classifying, pricing, extending and listing is a matter of detail that requires no further explanation. In taking the work in progress inventory, it is assumed that all finished material has been cleared properly and sent to finished stock prior to the close of the period, and all open production orders have been reduced to the net amount of unfinished work in progress. All component production in progress is counted and checked, a tag being issued fully describing the point of completion to which the same has progressed at the time of listing.

After making an adjustment for the value of any completed production sent to stock prior to the closing of the period, these tags are sent to the cost department as a check against the corresponding production cost sheet. In taking inventories of assembling production orders in progress, the work can be facilitated greatly if bills of material are prepared in advance to support the inventory tags; and this record, when properly priced in detail, facilitates the work of arriving at an accurate value of such materials.

In considering the valuation of inventories, individual consideration must be given to the kind of industry and also to the cost finding methods. In accordance with requirements as stipulated in the regulations for making income tax returns, pricing of inventories may be based upon "cost," or "cost or market whichever is lower," and special emphasis is placed upon the fact that whichever method is used, a change to another method cannot be made without special permission from the commissioner.

It is the opinion of the writer that inventories valued on the basis of "market" are both conservative and equitable, since it permits the results of each year to remain in absolute relationship to the results of other years, and does not unjustly penalize or reward a succeeding year for inventory carried forward from one period to another when it may have been purchased or manufactured under entirely different market conditions.

This can be illustrated readily by conditions during the war period, in which a considerable inventory may have been valued on the basis of a low cost, and liquidated during a rising market. The profits for such a period are not in relation to a reverse condition in which an inventory valued on the basis of a high cost is liquidated during a period of rapid reduction in selling price, even though the volume of business were the same in both instances. The error is apparent owing to the fact that the inventory at the beginning was not in relation to the replacement value, or its worth when compared with the purchasing power of cash during the period.

Although the pricing basis of "cost or market, which is lower," implies in its specification that adjustment is made, there seems to be no necessity for adjusting individual inventory items to less than their true market of replacement value for the purpose of being conservative; for if all inventory items are priced on the basis of "market," both conservatism and equity are considered fully.

Selecting Basis of Adjustment

The main object in adjusting incentories to market is the question of what to do with the resulting appreciation or depreciation, as it would be erroneous to take a profit or a loss without effecting a sale. This is answered with the fact that we split up our business years for the sake of convenience, treating each year as separate and unrelated. Actually this condition does not exist, since a business year may be normal or abnormal, and the results of past years are not buried, but are equally a hindrance

or a benefit for future years; and since year merges into year, a method of compensation should be in force to adjust an abnormal year to a normal status. Therefore, if during an inventory valuation at "market" an appreciation results, this should not be interpreted as a profit, but should be set aside as a reserve against periods in which the conditions are reversed, and a depreciation would result.

To arrive properly at market valuations of inventories, it is necessary to value the prime elements of manufacturing cost, as contained in each inventory item. In all items of manufacture, the content of raw material, as measured by weight or dimension plus a percentage of waste, is normally the same. Therefore, if a market price exists on the bulk material, a value covering the content of such material in a given article can be computed readily.

In all items of manufacture the content of productive time for producing the article should be relatively constant and since rates for various kinds of skilled and unskilled labor should be known, the content of direct labor can be determined easily for a given article.

If, therefore, a market price exists in the prime factors of material and labor, a market price must exist on burden as applicable to each manufactured article if the basis for distribution is kept in relation to a normal volume of manufacture; and on a manufacturing volume of 50 per cent normal it is not attempted to distribute such fixed expenses as taxes, rent, insurance and depreciation, which are always in relation to a 100 per cent volume of manufacture.

Were this not true, we should admit beforehand that we have no tangible basis for establishing a selling price, and that we are dependent upon good fortune alone as to the possible result at the end of a period. In certain industries confined to the manufacture of a special product, in which sales are made on a contract or cost plus basis, inventories should be based upon proportionate completion, or on an accrual of actual cost at the date of inventory. To sum up, inventory is a current asset, and should be valued in relationship to the purchasing power of cash at that period, and should be accounted for accurately.

If clerical errors in cost details have resulted in accumulating excessive material or labor charges against one job, and a relative deficit of material or labor charges against another, it would not equalize the error by adjusting to "cost or market, whichever is the lower" inasmuch as the first item would be reduced to market, which is lower, and the second item would remain constant because cost is lower. This could be overcome by the measurement of the content of the elements of manufacturing cost contained in each article.

Business cycles of several years are comparatively normal, but business years are not always normal. To compensate for the abnormalcy of one period as affecting a subsequent period, a reserve for absorbing the inventory appreciation or depreciation of separate periods is a safeguard against the difficulties that confront us at the present time. If we set aside the abnormal profit against a period of falling market prices, which result in abnormal losses, a safeguard would have been established against overexpansion of industries and the readjustment periods of the business cycle would be of shorter duration.

Equipment Depends upon Potential Market

Question:—We have a complete file of THE FOUNDRY extending back over the past three years but do not remember during that time seeing any article dealing with the methods involved in the manufacture of either service boxes and sleeves, or bell-end valve boxes and sleeves. We have made a few of these castings occasionally with indifferent success but now are contemplating making them in considerable numbers. We always have used dry sand cores, but have experienced trouble from chaplets and also from the cores blowing. To prevent the cores from crushing, the prints are shaved, resulting in an unsightly fin. Sometimes even where both castings apparently are perfect the sleeve will not slide down over the inner pipe. We should appreciate any information you may be able to give us on this subject.

Answer:—On page 495, Aug. 1, 1919 issue of THE FOUNDRY you will find a comprehensive article describing the methods in use at the Taylor & Bingham foundry, Buffalo, for the production of these castings. In addition to a domestic market this company ships castings to many foreign countries and therefore is equipped to handle approximately 100 tons of these castings daily. However, the molding equipment is made up of many self-contained units, each one producing its given quota of castings per day and could be adapted to a business having a smaller output by employing fewer units.

A simple and inexpensive rig by which a boy was enabled to make 25 service boxes a day may be seen described on page 111, March, 1919, THE FOUNDRY. At first the cores for these castings were made entirely in dry sand, but afterward were made with the lower half dry sand and the upper half green sand *blocked on*. Accurately fitting iron flasks replaced the loose, half burned wooden flasks formerly employed, and a half iron pattern firmly attached to a planed pattern plate replaced the old-time split wooden pattern with the flange corners all pounded out of shape with the rammer.

The service box sleeves were made in a similar manner except that they were poured directly on top through a small wedge gate and the core was made in a green sand hinged iron corebox. A comparatively stiff, winged core arbor was placed in the lower half of the corebox where the spaces between the wings were filled with sand and tucked with the fingers. A ¼-inch rod long enough to extend through each end of the corebox was laid on the exposed face of the arbor and then the upper half of the corebox was filled with sand, lightly packed with the hands, and then flopped rapidly onto the lower half. The vent rod was pulled out and after the upper half of the core box had been rolled back the core was lifted out of the lower half of the box by an extension on each end of the arbor, and lowered into the waiting mold.

Valve boxes and sleeves are made entirely in green sand. Dry sand cores usually are not accurate enough for this class of castings and besides they cost too much.

To make these castings properly you will need close fitting iron flasks with the ends cut out to embrace the core prints on the patterns. It is not necessary to provide room for runners on the sides of the pattern because the castings may be poured through two small pop gates punched through the top of the cope with a sprue cutter before the cope is lifted off.

You will need a hinged corebox. A stiff wood box, if handled carefully, will last a long time, but if the service is severe it would be advisable to make one of cast iron. The cast iron arbor is made up of a back bone and a number of half circle wings spaced about 4 inches apart. The last wing on the small end is made loose. It is made in the shape of a full circle provided with a hole in the center by which it may be slipped onto the end of the back bone and tightened with a wedge. After the valve box or sleeve casting is poured the end plate on the arbor is slipped off and then the arbor can be pulled out through the other end of the casting.

The New York office of the Northern Engineering Works, Detroit, has been removed to 30 Church St., New York. H. C. Rood is in charge.

Improves Malleable Anneal

Free Carbon Left in White-Heart Malleable by Reducing Annealing Temperature Improvement in Oven Design and Emptying and Reloading the Oven Before It Cools Entirely Are Recommended

BY ERNEST MILLER

IMPROVEMENTS in the operation of annealing malleable iron can be classified under two main headings. The one is technical, tending to improve quality and to maintain consistent repetition, while the second is commercial, reducing costs and increasing output.

It is important to realize that the annealing operation is really a form of heat treatment, and like all heat-treatment operations, its success depends on the condition of the material prior to treatment. Thus, in the case of malleable iron castings, the composition is of first importance. Unless careful analyses are made of the pig iron and scrap constituting the charge, and of the coke used for cupola melting, it becomes difficult to obtain castings conforming from day to day to the desired composition.

For successful foundry practice in making white-heart malleable castings, the two main factors are silicon and sulphur. For cupola melting the charge should contain 0.8 to 0.9 per cent silicon and not to exceed 0.1 per cent sulphur. Of course, more than one grade of pig is used, because seldom is a single grade of the correct composition. The effect of melting is to reduce the silicon and increase the sulphur. As the result of 58 consecutive runs in one cupola, the loss in silicon varied from 0.02 to 0.16 per cent, and the average loss for the whole series was 0.067 per cent. The gain in sulphur, using coke of average quality, varied from 0.022 to 0.159 per cent, giving an average for the series of 0.076 per cent. Since the charges usually include a proportion of hard scrap containing less silicon and more sulphur than the pig iron, the resulting castings would always be considerably poorer in silicon and richer in sulphur than the pig iron used. The net result of making up charges with 30 to 50 per cent of hard scrap, using the irons already specified, was to produce castings containing approximately 0.70 to 0.80 per cent silicon and 0.20 to 0.25 per cent sulphur. The phosphorus increased slightly, about 0.01 to 0.02 per cent, and the manganese was reduced by 0.05 to 0.20 per cent. The latter elements are not quite so important as silicon and sulphur, but should come in for consideration when the sulphur is high. Metal of the composition given is not suitable for all classes of castings, but gives good results in the final annealed castings for the average run.

It is commonly agreed that in the white-heart process of annealing, the carbon is removed from the iron by the action of gases which penetrate the metal. Under the influence of heat carbon dioxide is formed and this, coming into contact with the carbon in the iron, combines with it, forming another gas, carbon monoxide. This change in the gases causes a continuous movement, or flow, in and out of the casting with the result that the carbon monoxide comes into contact with the hematite ore used for packing. Then another chemical action takes place, the gas being reconverted to carbon dioxide which again travels into the iron and repeats the cycle of changes again and again.

Cementite Dissociates

In addition to this action of the gases another change takes place. At a certain temperature, dependent on the proportion of silicon and sulphur present, that extremely hard constituent of the casting called cementite commences to dissociate or break up into free carbon and iron. The carbon takes the form of small nodules and not the flakey form usually associated with gray iron. This nodule formation does not impart the same weakness to the casting that the flakey form does, but at the same time it is essential that the size and number of the nodules should be regulated. If they are coarse and large the strength of the casting is reduced. In a true white-heart casting the bulk of the carbon is removed by the action of the gases and what remains should be in the form of pearlite, no free carbon being present. But this is seldom obtained and commercially is not a practical proceeding. The carbon which separates in the free state, as a rule, is allowed to remain in the casting. This is important because otherwise the annealing operation would be long and costly. The extreme slowness of the carbon removal by the gases presents a difficulty. With castings of thick sections the operation is long and costly and is attended by considerable risks such as peeling or oxidation of the outer layers of the castings. It is known that high annealing temperatures increase the activity of the gases considerably and that in consequence the carbon is removed more quickly and completely. But this increased activity is the very thing that must be guarded against, because as soon as the outer layers are decarbonized the iron itself oxidizes and becomes worthless. Therefore it is necessary to retard the carbon removal by such means as reducing the proportion of silicon or increasing the percentage of sulphur, but the increase of sulphur in the metal is undesirable. Therefore it would be well to give attention to the production of what might be termed the soft casting.

An examination of the structure of such a casting shows the presence of pearlite which undoubtedly gives strength to the material and accounts for white-heart castings having a higher tensile strength than black-heart castings. The free carbon or graphite has a considerable influence on the strength. The more carbon which separates from the combined state, the less there is to remove, and consequently the less there is for the gases to do. On the other hand, free carbon causes loss of strength and ductility. This means finding a compromise which will give the required qualities of strength and ductility without the necessity for unduly prolonged annealing.

The size and number of the carbon nodules also must be considered and offers an opportunity for improvement. The factors governing this are temperature, silicon content and sulphur. Low annealing temperature favors the formation of small nodules and therefore tends to produce better results, while a more uniform structure also is obtained. An annealing temperature of 900 degrees Cent. for a period of 100 hours produces a most desirable structure in an iron of the analysis al-

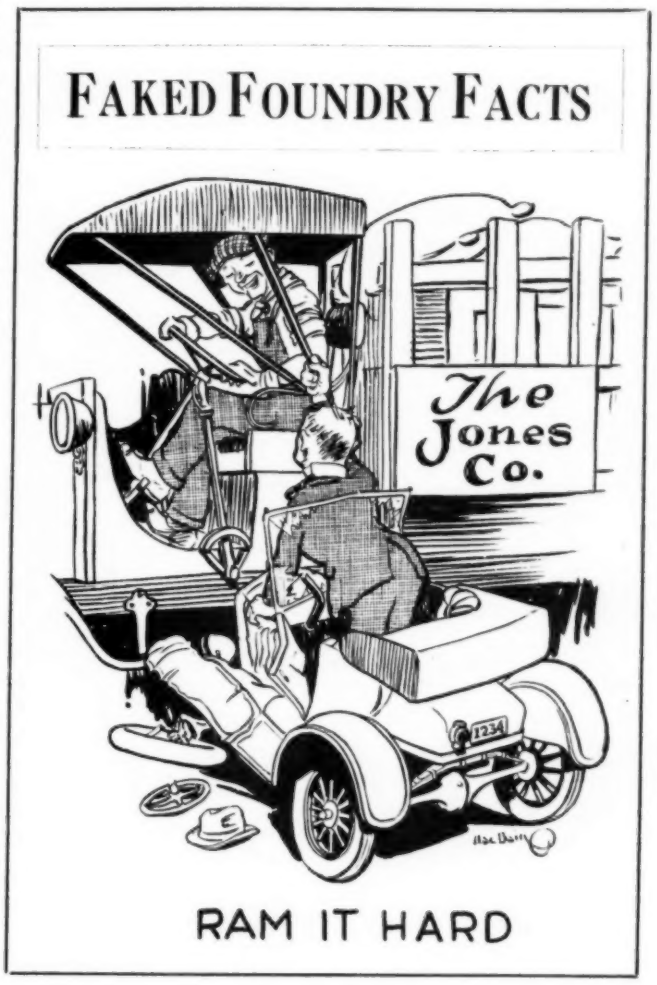
Paper presented at the March meeting of the Birmingham branch of the Institution of British Foundrymen.

ready suggested. Higher temperature would tend to coarsen the graphite nodules and therefore should be avoided. Sulphur retards the separation, and its reduction, and therefore, lessens the time for annealing and the temperature required. Silicon exerts an influence which tends to coarsen the graphite areas, and consequently if the sulphur is reduced the silicon also can be reduced.

The great variations in the thickness of castings can be dealt with successfully only by an annealing process which operates uniformly throughout the casting. With hard iron containing 0.75 percent silicon and 0.20 per cent sulphur, castings with sections up to 1½ inches thick were annealed in the same time as those of ¼-inch cross section. Some thinner than ¼ inch were almost pure white-heart in character and yet were free from troubles such as peeling and skinning. The annealing temperature for this composition was approximately 900 degrees Cent., which meant that the oven operated at about 950 degrees Cent. At the commencement of the annealing operation the oven was raised to about 1000 degrees Cent. This temperature was maintained for 24 to 30 hours to ensure thorough heating of the work and initiate the carbon separation. The time allowed was approximately 30 hours for heating up to 1000 degrees Cent. and then 95 to 100 hours until the time firing was stopped. Thus, with machine charging and discharging, a complete heat could be obtained every seven days. A fall in temperature toward the end of the run produced a better casting and tended to prevent complete decarbonization of the outer layers. Thus it would be of advantage to reduce the oven temperature gradually to about 920 degrees Cent.

The usual form of coal-fired annealing oven is notoriously inefficient, not only in regard to fuel consumption, but also as to heat distribution and temperature uniformity. Many foundries are entirely dependent on the annealer who, through costly experience with the oven's peculiarities is the only man who can pack it so as to obtain the least amount of defective work. Even with this knowledge a considerable risk exists of sending out hard castings or of over-annealing. In one type of oven commonly used, only about 2 to 3 per cent of the heat in the fuel is employed usefully. This explains why in some cases 1½ or even 2 tons of coal are required to anneal a ton of castings.

One big source of loss is incomplete combustion. This is brought about by the chilling action of the cold pots on the gases which are reduced to a temperature below their ignition point and consequently a portion of them escaped from the furnace unburned. This defect is always present to some extent in any furnace where heat generation and heat absorption are carried out in the same chamber. The next serious loss is due to allowing the waste gases to escape at the full temperature of the chamber, conveying away a large amount of heat which should be reclaimed and returned to the furnace by means of some form of regenerative or recuperative system. Radiation losses are also large. An increase in thickness of the brickwork would in many cases reduce this loss materially.



Hot Iron Required for Light Castings

Question: We should like to have your opinion on whether there is any advantage in arranging the molds for light castings in an inclined position and if so is it preferable to place the gates at the low side of the mold and thereby force the iron to run up or to place the gates at the highest point on the mold and allow the iron to run down into the castings. We have recently experienced a considerable amount of trouble with a gate of light patterns in which the outside edges do not seem to run, and have been wondering if elevating one side of the mold would make any difference.

Answer: The practice of pouring molds while in an inclined position is common in brass foundries devoted to the manufacture of light castings. This is due partly to the fact that the metal runs easier and partly to the fact that the molds are stacked and therefore in a more convenient position for pouring when set on an incline. However, iron of a suitable analysis is more fluid than brass and should require no manipulation of the mold to make it run any reasonable distance. If it seems necessary to incline the molds by all means pour them from the high side. We are inclined to think that the trouble lies in your iron. An iron running 0.60 per cent phosphorus or higher and with a silicon content of approximately 3.00 per cent melted smoking hot and caught in a hand ladle direct from the spout will run the thinest castings.

W. J. Nelson, Beadmont, Mass., formerly president of the West Albany Molding Sand Co., West Albany, N. Y., has sold out his interests in that company. His business now is converting the burnt waste sands of all kinds such as core sands, sand blast, etc. into molding sand.

The U. S. Pipe and Foundry Co., E. 26th street, Cleveland, is demolishing its main foundry building, and will for the present operate the smaller unit only, to satisfy local needs.

Select Sand for Brasswork--I

Venting Properties Should Be Secured from Open Grain and Vent Wires Little Used—Bond Affected by Its Composition—Clay Fusing at High Temperature Is Desirable

BY CHARLES VICKERS

PRODUCTION of successful castings in any metal or alloy depends upon skillfully carrying out a sequence of operations connected with the construction of molds, the melting and alloying of metals, the manner in which it is admitted and poured into the molds, and its temperature on arriving at the molds.

The first important consideration is the molds. As is well known these are made of sand, other materials rarely being substituted. Sand used in molding is mainly composed of the substance known as silica which has a certain and definite chemical composition. Therefore, while sands may vary, the difference between one sand and another will apply more to the size and shape of the individual grains, the character of the bond, and the amount of silt or finely divided material that may be mixed therewith, rather than to any wide variation in a chemical sense, such as would obtain if the silica base could be changed to one of zirconia or other refractory oxide.

The silica in molding sands is mixed with plastic substances which, when dampened, bind the individual grains together, and the stronger they are held, the better the sand for making molds because it will not break so readily during molding operations. When the sand contains no bonding materials, it is known as sharp sand, and an artificial bond has to be added before it can be used.

Another property necessary to a molding sand is permeability, meaning that it must be porous to the gases developed when the molds are cast. If these gases are unable to escape through the walls of the mold to the atmosphere, they will gather until sufficient pressure is stored and force their way through the metal. The mold is then said to *blow* and the metal may be ejected forcibly from the openings.

Sometimes instead of the mold blowing the gases will blow thin patches of sand from the mold walls. The mold will *scalp* like a damp crucible and little, if any, disturbance will be noticeable as the mold is filled. As the metal is molten it will fill the little valley in the mold from which the sand has been ejected, thus producing a lump on the casting. This lump is called a scab, and the sand that came away is distributed at points in the casting producing holes, known as *sand holes*. Frequently some of this detached sand will be washed up in the risers, advertising the fact of something being wrong with the casting.

Sometimes instead of patches of the mold being detached by the gases, the bond of the sand will be destroyed at points where the flow of the metal is severe, and the sand of the mold wall will be carried away as individual grains instead of as patches. This is known as cutting, and probably is related to scabbing as it occurs when too fine a sand is used in constructing a mold. It also occurs when a sand is too weak, that is through original lack of bond, or because it has been used too long. In the effort to avoid these causes of disaster to his molds, the molder has recourse to his vent wire, a long steel wire of any diameter he thinks suitable to the occasion. He jabs this into the sand of the mold down to the vicinity of the pattern, and sometimes into the pattern when the latter is of wood. While it may appear like sacrilege to cast aspersions on this faithful tool, nevertheless the modern tendency is to avoid its use as much as possible by the selection of molding sands possessing sufficient natural permeability to vent the gases without artificial aid.

Pockets Should Be Marked

When pockets of green sand are formed either in the drag or cope part of a mold, the use of the vent wire is unavoidable, but if before any sand is put over the pattern, the location of these pockets is marked on the flask sides, a few strokes of the vent wire through the heart of the sand pocket will be better than dozens of aimless jabs without a knowledge of the exact spot where the pocket lies.

When more than a certain amount of the bonding material is mixed with the sand, the latter will lose its permeability. Therefore, the strength of the sand while green or damp is limited by the necessity for this permeability.

What is known as the silt is the finely divided material in a sand, and naturally the amount of this admixture will vary with different sands. As this silt will sift between the grains and close the passages between them thus holding back the gases, there is a limit to the amount of silt there should exist in a molding sand. However, a little silt may be necessary to get a casting of the required smoothness of skin.

The silt content of a sand will increase with use, because some of the sand grains are broken up, also the bond is gradually changed, some of it being reduced to dust. This tendency has to be counteracted to continue the successful production of castings.

The chemical constituents of a molding sand are silica (oxide of silicon), alumina (oxide of aluminum), ferric and ferrous oxides (oxides of iron), magnesia (oxide of magnesium), lime (oxide of calcium), soda (oxide of sodium), potash (oxide of potassium) and small amounts of other substances such as manganese and titanium compounds. The principal bonding agents are the alumina and the iron oxides, and usually these two are combined with silica to form a ferruginous clay which time and weather have so distributed that it coats each grain of sand uniformly. Then when the sand is moistened these clay films adhere to each other, holding the grains of sand together. The bond of a molding sand functions in proportion to its property of absorbing moisture; thus dry clay is a granular material that is converted by water into a plastic and sticky mass. The water is just as important as the other constituents of the sand. The proportion must be regulated for if the sand is too wet it will be impossible to keep the metal in the mold; it will be blown out of the pouring heads with such energy as to be dangerous. One of the first things a molder must learn, is to know when his sand is too moist. It is well to know that all sands are not alike in respect to the amount of moisture they can hold without becoming *wet*. Sands high in iron oxides, or in lime, can hold more moisture than sands deficient in these substances, and as a consequence they make stronger molds, for, as is well known, when there is insufficient moisture in a sand it is difficult to lift copes and draw patterns because the sand crumbles and breaks away.

When molds are poured the sand is partially dried by the hot metal and after the removal of the castings water has to be added to bring the sand to its former degree of plasticity. In the

majority of foundries this water is supplied from a hose or a sprinkling can and the amount is gauged by the experience of the operator. In the minority of shops the water content is under the control of a laboratory and additions are made as necessary to hold the percentage of moisture at the standard decided upon. This will vary with the water-holding power of the sand. Theoretically, the amount of moisture in a molding sand should be as low as possible, but in this case theory and practice do not keep pace together, as any molder who has tried working his sand on the *dry side* knows. The sand should be worked as damp as possible and have the metal lie against the walls of the mold without *shimmying*, a word that exactly describes the action of molten metal, and especially aluminum, when in contact with sand which has been rammed slightly too hard, or with mold walls which are too damp. The latter is a fertile source of porous castings. Usually the degree of dampness is determined by the *feel* of the sand which requires experience, but if a sand when squeezed to a ball, or egg shape, holds together strongly, and does not get wet when the ball is bounced upward a few inches and is caught in the cupped hand repeatedly for several seconds, it can be decided the moisture content is not at fault. It is surprising how this rough and ready test will show the moisture in a sand by bringing it to the surface. Sands that are too damp quickly appear like mud.

When a sand wets with difficulty after the molds are shaken out, and the sprinkled water runs off the heap in the manner it is supposed to run off the proverbial duck's back, it is lacking in water-absorbing bond, and will appear *wet* when a relatively small amount of water has been added. Such sand will be weak and cause trouble due to bad lifts and drop outs, and it will be eroded by the metal passing through the gates and mold, producing dirty castings. Such a condition should be remedied as soon as it is discovered by the addition of about 50 per cent of new molding sand to all the old sand in use. It will be better to throw the surplus old sand away than to permit its use to lower the morale of the molders, for this would mean that after the most extraordinary time-consuming precautions had been taken to ensure good castings, the majority poured would be bad.

Such experiences are not uncommon in brass molding shops and call for radical changes, therefore, it is advisable after introducing the new sand to investigate the fitness of the molding sand, when new, for the work for which it is being used. Samples should be sent to the laboratory for analyses, both chemical and mechanical; its history should be studied with a view to determine how long a time is required for it to become worn out, for if it quickly arrives at such a condition it is of inferior quality and a change should be made by blending it with a different sand which will confer the qualities it lacks; or it may be discarded entirely.

Opinions vary as to the value of some of the constituents of molding sands. It is generally conceded that a high silica content is desirable, provided the other necessary qualities are also present. Silica is cheap and plentiful and is found in a natural state ready mixed with bonding agents exactly as required for molding purposes. But it is not an ideal material for this purpose, because it is a changeable substance when heated, and no doubt this property is responsible for some of the difficulties experienced in casting metals. Thus, when heated to between 1000 and 1100 degrees Fahr., it undergoes its first change; that from alpha to beta quartz, which change is accompanied by expansion. This would mean that if core ovens were heated to the temperature mentioned, the cores would be swelled. Due to the danger of burning the bond in the cores this temperature is not reached. A second expansion occurs at 1650 degrees Fahr., and both these temperatures are covered by the temperature of the copper-base alloys, but fortunately the skin of solidifying metal is sufficiently strong to resist the pressure exerted by the expanding silica. Aluminum, however, remains liquid for a relatively long period; then as it solidifies is tender for a period, and if its pouring temperature coincides with the temperature change of silica, the castings will be cracked by the expansion thereof. This is one reason it is advisable to pour aluminum alloys under 1600 degrees Fahr.

Melting Point High

Silica vitrifies or fuses at a temperature of 2950 degrees Fahr. While this is beyond the pouring temperature of most copper-base alloys, it is near enough to that of steel and nickel-alloy castings for the sand to burn on to them, as the melting point of mild steel is 2690 degrees Fahr., that of nickel 2732 degrees Fahr., and that of Monel metal 2480 degrees Fahr., and in order to pour into molds a considerable amount of superheat is required, which brings the pouring temperature near the vitrifying temperature of the silica. When these peculiarities of silica are considered it is surprising there is so little trouble traceable to them in the production of castings.

The alumina and the iron oxides are the principal adhesive substances in the sand, and opinions, also differ as to their relative value. Little fault is found with the alumina as it is an adhesive of high melting point (pure alumina melts at 3722 degrees Fahr.) but due to its plasticity it will clog the crevices between the grains of silica if too much of it is present in the form of clay which coats each grain of sand (silica). If this envelope is of a certain thickness it is evident that when compacted a solid mass will result. Under such conditions there would be no open pores and no escape of gases which are generated in the mold would be possible. Then the mold would blow.

The content of clay in a modern molding sand has to be within certain limits; it may vary from 5 to 17 per cent, and it is a singular thing that not always is the sand highest in alumina the most plastic, for the other constituents exert a modifying influence. However, clay itself can be used for molds, and it has been so used from the dawn of history and probably farther back. Even today clay is used for molding by the Chinese, and their wonderful specimens of cast iron founding, such as bowls and kettles, are produced from clay molds which are used several times over. The clay mold has to be baked and must be hot when the metal is poured into it.

As a molding sand is used the clay bond bakes out; the coating of clay around each grain of sand that comes in contact with the hot metal is changed to brick or earthenware, then it cracks and falls off the sand which thus progressively deteriorates. Sometimes clay additions are made constantly to the sand with fairly good results as a rejuvenator, but as a general rule, the bond is restored by additions of new sands made with regularity. The amount of new sand necessary to keep the molding sand in good condition is given by some authorities as one fourth the weight of the castings made per month, others use 1 pound of sand to every 2½ pounds of castings made for heavy work, and 1 pound of sand for each pound of castings for light work.

Molding sands vary in color from a light yellow to a deep red, the coloring agent being the iron, but the depth of color is due more to the state of oxidation of the iron than to the amount present. Some believe that iron is detrimental as it is supposed to lower the melting point of the sand. This view is disputed by those who contend the iron is an important constituent of molding sands, especially for green-sand molding, that it is refractory and does not act as a flux for the silica. The iron bond is not affected by the heat the same as the clay bond, as it does not bake to a hard and permanent mass like clay, then crumble and reduce the permeability of the sand. It is

Select Sand for Brasswork--I

Venting Properties Should Be Secured from Open Grain and Vent Wires Little Used—Bond Affected by Its Composition—Clay Fusing at High Temperature Is Desirable

BY CHARLES VICKERS

PRODUCTION of successful castings in any metal or alloy depends upon skillfully carrying out a sequence of operations connected with the construction of molds, the melting and alloying of metals, the manner in which it is admitted and poured into the molds, and its temperature on arriving at the molds.

The first important consideration is the molds. As is well known these are made of sand, other materials rarely being substituted. Sand used in molding is mainly composed of the substance known as silica which has a certain and definite chemical composition. Therefore, while sands may vary, the difference between one sand and another will apply more to the size and shape of the individual grains, the character of the bond, and the amount of silt or finely divided material that may be mixed therewith, rather than to any wide variation in a chemical sense, such as would obtain if the silica base could be changed to one of zirconia or other refractory oxide.

The silica in molding sands is mixed with plastic substances which, when dampened, bind the individual grains together, and the stronger they are held, the better the sand for making molds because it will not break so readily during molding operations. When the sand contains no bonding materials, it is known as sharp sand, and an artificial bond has to be added before it can be used.

Another property necessary to a molding sand is permeability, meaning that it must be porous to the gases developed when the molds are cast. If these gases are unable to escape through the walls of the mold to the atmosphere, they will gather until sufficient pressure is stored and force their way through the metal. The mold is then said to *blow* and the metal may be ejected forcibly from the openings.

Sometimes instead of the mold blowing the gases will blow thin patches of sand from the mold walls. The mold will *scalp* like a damp crucible and little, if any, disturbance will be noticeable as the mold is filled. As the metal is molten it will fill the little valley in the mold from which the sand has been ejected, thus producing a lump on the casting. This lump is called a scab, and the sand that came away is distributed at points in the casting producing holes, known as *sand holes*. Frequently some of this detached sand will be washed up in the risers, advertising the fact of something being wrong with the casting.

Sometimes instead of patches of the mold being detached by the gases, the bond of the sand will be destroyed at points where the flow of the metal is severe, and the sand of the mold wall will be carried away as individual grains instead of as patches. This is known as cutting, and probably is related to scabbing as it occurs when too fine a sand is used in constructing a mold. It also occurs when a sand is too weak, that is through original lack of bond, or because it has been used too long. In the effort to avoid these causes of disaster to his molds, the molder has recourse to his vent wire, a long steel wire of any diameter he thinks suitable to the occasion. He jabs this into the sand of the mold down to the vicinity of the pattern, and sometimes into the pattern when the latter is of wood. While it may appear like sacrilege to cast aspersions on this faithful tool, nevertheless the modern tendency is to avoid its use as much as possible by the selection of molding sands possessing sufficient natural permeability to vent the gases without artificial aid.

Pockets Should Be Marked

When pockets of green sand are formed either in the drag or cope part of a mold, the use of the vent wire is unavoidable, but if before any sand is put over the pattern, the location of these pockets is marked on the flask sides, a few strokes of the vent wire through the heart of the sand pocket will be better than dozens of aimless jabs without a knowledge of the exact spot where the pocket lies.

When more than a certain amount of the bonding material is mixed with the sand, the latter will lose its permeability. Therefore, the strength of the sand while green or damp is limited by the necessity for this permeability.

What is known as the silt is the finely divided material in a sand, and naturally the amount of this admixture will vary with different sands. As this silt will sift between the grains and close the passages between them thus holding back the gases, there is a limit to the amount of silt there should exist in a molding sand. However, a little silt may be necessary to get a casting of the required smoothness of skin.

The silt content of a sand will increase with use, because some of the sand grains are broken up, also the bond is gradually changed, some of it being reduced to dust. This tendency has to be counteracted to continue the successful production of castings.

The chemical constituents of a molding sand are silica (oxide of silicon), alumina (oxide of aluminum), ferric and ferrous oxides (oxides of iron), magnesia (oxide of magnesium), lime (oxide of calcium), soda (oxide of sodium), potash (oxide of potassium) and small amounts of other substances such as manganese and titanium compounds. The principal bonding agents are the alumina and the iron oxides, and usually these two are combined with silica to form a ferruginous clay which time and weather have so distributed that it coats each grain of sand uniformly. Then when the sand is moistened these clay films adhere to each other, holding the grains of sand together. The bond of a molding sand functions in proportion to its property of absorbing moisture; thus dry clay is a granular material that is converted by water into a plastic and sticky mass. The water is just as important as the other constituents of the sand. The proportion must be regulated for if the sand is too wet it will be impossible to keep the metal in the mold; it will be blown out of the pouring heads with such energy as to be dangerous. One of the first things a molder must learn, is to know when his sand is too moist. It is well to know that all sands are not alike in respect to the amount of moisture they can hold without becoming *wet*. Sands high in iron oxides, or in lime, can hold more moisture than sands deficient in these substances, and as a consequence they make stronger molds, for, as is well known, when there is insufficient moisture in a sand it is difficult to lift copes and draw patterns because the sand crumbles and breaks away.

When molds are poured the sand is partially dried by the hot metal and after the removal of the castings water has to be added to bring the sand to its former degree of plasticity. In the

majority of foundries this water is supplied from a hose or a sprinkling can and the amount is gauged by the experience of the operator. In the minority of shops the water content is under the control of a laboratory and additions are made as necessary to hold the percentage of moisture at the standard decided upon. This will vary with the water-holding power of the sand. Theoretically, the amount of moisture in a molding sand should be as low as possible, but in this case theory and practice do not keep pace together, as any molder who has tried working his sand on the *dry side* knows. The sand should be worked as damp as possible and have the metal lie against the walls of the mold without *shimmying*, a word that exactly describes the action of molten metal, and especially aluminum, when in contact with sand which has been rammed slightly too hard, or with mold walls which are too damp. The latter is a fertile source of porous castings. Usually the degree of dampness is determined by the *feel* of the sand which requires experience, but if a sand when squeezed to a ball, or egg shape, holds together strongly, and does not get wet when the ball is bounced upward a few inches and is caught in the cupped hand repeatedly for several seconds, it can be decided the moisture content is not at fault. It is surprising how this rough and ready test will show the moisture in a sand by bringing it to the surface. Sands that are too damp quickly appear like mud.

When a sand wets with difficulty after the molds are shaken out, and the sprinkled water runs off the heap in the manner it is supposed to run off the proverbial duck's back, it is lacking in water-absorbing bond, and will appear *wet* when a relatively small amount of water has been added. Such sand will be weak and cause trouble due to bad lifts and drop outs, and it will be eroded by the metal passing through the gates and mold, producing dirty castings. Such a condition should be remedied as soon as it is discovered by the addition of about 50 per cent of new molding sand to all the old sand in use. It will be better to throw the surplus old sand away than to permit its use to lower the morale of the molders, for this would mean that after the most extraordinary time-consuming precautions had been taken to ensure good castings, the majority poured would be bad.

Such experiences are not uncommon in brass molding shops and call for radical changes, therefore, it is advisable after introducing the new sand to investigate the fitness of the molding sand, when new, for the work for which it is being used. Samples should be sent to the laboratory for analyses, both chemical and mechanical; its history should be studied with a view to determine how long a time is required for it to become worn out, for if it quickly arrives at such a condition it is of inferior quality and a change should be made by blending it with a different sand which will confer the qualities it lacks; or it may be discarded entirely.

Opinions vary as to the value of some of the constituents of molding sands. It is generally conceded that a high silica content is desirable, provided the other necessary qualities are also present. Silica is cheap and plentiful and is found in a natural state ready mixed with bonding agents exactly as required for molding purposes. But it is not an ideal material for this purpose, because it is a changeable substance when heated, and no doubt this property is responsible for some of the difficulties experienced in casting metals. Thus, when heated to between 1000 and 1100 degrees Fahr., it undergoes its first change; that from alpha to beta quartz, which change is accompanied by expansion. This would mean that if core ovens were heated to the temperature mentioned, the cores would be swelled. Due to the danger of burning the bond in the cores this temperature is not reached. A second expansion occurs at 1650 degrees Fahr., and both these temperatures are covered by the temperature of the copper-base alloys, but fortunately the skin of solidifying metal is sufficiently strong to resist the pressure exerted by the expanding silica. Aluminum, however, remains liquid for a relatively long period; then as it solidifies is tender for a period, and if its pouring temperature coincides with the temperature change of silica, the castings will be cracked by the expansion thereof. This is one reason it is advisable to pour aluminum alloys under 1600 degrees Fahr.

Melting Point High

Silica vitrifies or fuses at a temperature of 2950 degrees Fahr. While this is beyond the pouring temperature of most copper-base alloys, it is near enough to that of steel and nickel-alloy castings for the sand to burn on to them, as the melting point of mild steel is 2690 degrees Fahr., that of nickel 2732 degrees Fahr., and that of Monel metal 2480 degrees Fahr., and in order to pour into molds a considerable amount of superheat is required, which brings the pouring temperature near the vitrifying temperature of the silica. When these peculiarities of silica are considered it is surprising there is so little trouble traceable to them in the production of castings.

The alumina and the iron oxides are the principal adhesive substances in the sand, and opinions, also differ as to their relative value. Little fault is found with the alumina as it is an adhesive of high melting point (pure alumina melts at 3722 degrees Fahr.) but due to its plasticity it will clog the crevices between the grains of silica if too much of it is present in the form of clay which coats each grain of sand (silica). If this envelope is of a certain thickness it is evident that when compacted a solid mass will result. Under such conditions there would be no open pores and no escape of gases which are generated in the mold would be possible. Then the mold would blow.

The content of clay in a modern molding sand has to be within certain limits; it may vary from 5 to 17 per cent, and it is a singular thing that not always is the sand highest in alumina the most plastic, for the other constituents exert a modifying influence. However, clay itself can be used for molds, and it has been so used from the dawn of history and probably farther back. Even today clay is used for molding by the Chinese, and their wonderful specimens of cast iron founding, such as bowls and kettles, are produced from clay molds which are used several times over. The clay mold has to be baked and must be hot when the metal is poured into it.

As a molding sand is used the clay bond bakes out; the coating of clay around each grain of sand that comes in contact with the hot metal is changed to brick or earthenware, then it cracks and falls off the sand which thus progressively deteriorates. Sometimes clay additions are made constantly to the sand with fairly good results as a rejuvenator, but as a general rule, the bond is restored by additions of new sands made with regularity. The amount of new sand necessary to keep the molding sand in good condition is given by some authorities as one fourth the weight of the castings made per month, others use 1 pound of sand to every 2½ pounds of castings made for heavy work, and 1 pound of sand for each pound of castings for light work.

Molding sands vary in color from a light yellow to a deep red, the coloring agent being the iron, but the depth of color is due more to the state of oxidation of the iron than to the amount present. Some believe that iron is detrimental as it is supposed to lower the melting point of the sand. This view is disputed by those who contend the iron is an important constituent of molding sands, especially for green-sand molding, that it is refractory and does not act as a flux for the silica. The iron bond is not affected by the heat the same as the clay bond, as it does not bake to a hard and permanent mass like clay, then crumble and reduce the permeability of the sand. It is

thought to have great water-holding power and to confer strength on the moist sand, also to be important in the production of smooth castings. The iron bond is gradually eliminated also by chemical change involving reduction due to contact with hot metal in the presence of carbon. This bond is restored by additions of new sand, and experience shows that if the restoring sand is high in ferruginous bond the improvement effected by its addition is all the greater.

The other constituents of molding sands are lime or calcium salts, magnesia, and the hydrated oxides of sodium and potassium. Lime is usually unfavorably regarded, but there is no unanimity about it as some regard it as a valuable constituent of molding sand, claiming it assists in spreading the moisture over the grains of silica. Lime is such an infusible substance that it is difficult to understand how it can be harmful; in fact, at one time it was used as a facing powder for dusting on molds for bronze in place of flour. This practice was not persisted in on account of the pungency of the lime, although it gave good results. Lime is the oxide of calcium, limestone is the carbonate, and this latter ubiquitous substance, when heated, changes to the oxide. In so doing it gives up carbon dioxide gas. This reaction takes place at a red heat and is reversible at a higher temperature.

When the sand contains particles of limestone, chalk, marble, or calcspar, which are all forms of calcium carbonate, the little grains here and there will be pressed against the pattern when it is rammed in the sand, and when the mold is poured, contact with the hot metal will at first produce an evolution of gas which like a little spear will pierce the metal and as the temperature of the little grain of carbonate rises and the reabsorption period commences the slight relaxation of pressure thus created permits the adjacent layer of metal to flow back and enclose the little spear of gas, producing a needle-like hole under the skin of the casting. These holes are small, isolated, and appear here and there quite aimlessly. They are not unusual in brass castings and can sometimes be detected on the rough casting as a speck which when probed is discovered to be a hole. They can be stopped by using a facing of sand free of the carbonate particles.

Calcium hydroxide, slacked lime as it is called, is formed when water is added to the oxide, and naturally if free lime is present in a molding sand it will be slacked on account of the moisture in the sand. When slacked lime is heated, as it would be in contact with metal, it gives up its water and reverts to the unslacked, or oxide condition. The water so driven off would not be likely to enter the metal as steam, for on parting from its water the hydrate is converted into a porous mass through which steam can readily pass, therefore, any steam generated would be driven into the sand backing. These considerations lend truth to the claim of some that lime has a value in molding sands, especially for brass molding and that it may be present up to 5 per cent without harm. Certain it is that molding sands containing up to 1.5 per cent of lime are being used successfully in aluminum foundries, and such sand is noted for the strength of its bond which permits deep pockets of sand to be lifted by molding machines.

Salts Readily Fusible

The soda and the potash contents of molding sand also come in for condemnation, as these salts are supposed to readily fuse and form silicates, acting as fluxes. However, silica is not as easy material to flux as anyone accustomed to making fire assays has discovered, and while silica or sand, forms glass when united with soda and lime the proportions of these salts which is required is much greater than is usually found in molding sands.

When the melting point of the silica is exceeded by the temperature of the metal poured into the mold, the silica can be expected to vitrify and fuse onto the castings, as in steel molding, and small amounts of fluxing materials may be undesirable impurities as they may lower the fusing temperature of the silica and favor the burning on of the sand. However, in the case of brass and bronze molding no difficulties need be anticipated from soda and potash when their combined content is under 3 per cent. Thus No. 1, Albany sand, as used for stove plate and some brass castings, may contain over 2 per cent potash and 1.5 per cent soda; a Newport sand a little over 1.25 per cent potash and 0.5 per cent soda, while the noted English Mansfield sand, which is red in color and exceedingly tough after milling, may carry from one to several per cent of potash, a small amount of soda and around 1.5 per cent of lime.

An excellent binder for runner cores of sharp sand is silicate of soda or water glass. It also is used as a binder for furnace linings, but when used for copper and bronze no fusion of the layer of sand next the metal has ever been noted in the experience of the writer.

While the chemical constituents of a sand are given by the analysis as silica, alumina, and the various oxides of the elements composing it, the sand is not such a simple admixture. It is a mixture of groups of these various constituents such as silica, feldspar, clay and hydrated ferric oxide. Thus feldspar is a silicate of aluminum, potassium, lime and sodium, and may vary in its content of potassium and sodium; while clay is a silicate of aluminum containing both silica and alumina. This renders it difficult to duplicate a sand from the analysis, as the various constituents would first have to be arranged in groups. The work would be similar to duplicating an alloy from its analysis, when it had been put together by melting a number of separate hardeners.

How and Why in Brass Founding

By Charles Vickers

Metal To Resist Acid

Some time ago you furnished us with a formula for acid resisting metal as follows: Copper 89.5 per cent; tin 10 per cent; 30 per cent manganese copper, 0.5 per cent. We now desire to supply a similar metal that will resist sulphuric acid. We take it that this composition will answer the same purpose, but do not wish to make any recommendations until we hear from you.

The alloy as given here will resist sulphuric acid better than it will resist muriatic acid, as the latter acid is much more destructive in its action on nonferrous metals than sulphuric acid. Strictly speaking there is no copper-tin alloy known that will resist even weak solutions of muriatic or hydrochloric acid, but the one given above is the best that can be made, because the manganese will so deoxidize it, that it will be an homogenous alloy and will contain no oxide specks that will invite

attack by the acid which is used. However, a good homogeneous high nickel alloy would be better than the copper-tin alloy given for sulphuric acid, but the great trick is to get such alloys homogenous, and then they would fail miserably in the case of the hydrochloric acid. The foregoing remarks apply to solutions of the acids at room temperatures, when heated above room temperature, the poor alloys stand no chance at all. Putting lead into such alloys does not help them in the least, for hot sulphuric acid solution will dissolve out the lead, at the same time attacking the copper, so in such cases it is necessary to use some vitrified substance as the container, or the acid resisting silicon iron alloys.

Coverings for Use in the Melting of Brass

Will you be kind enough to suggest a good covering for metal melted in a non-crucible furnace, using oil as fuel? How should fluorspar be used in such a furnace? Does an electric furnace of the drum type with end electrodes, require a covering for the metal? All the metal referred to is of the composition, copper 81 per cent, zinc, 10 per cent; lead, 7 per cent; and tin, 2 per cent.

In melting brass about all that is required is to keep it covered and thus protected from the gases generated during the combustion of the fuel. It is not desirable for the flux or slag used for the above purpose to give off gases or to absorb any part of the metals in the alloy. Otherwise, there is a waste. Melting in a closed or partly closed furnace is a different proposition to melting in a crucible. In the latter no pressure is built up, so that the gases generated by charcoal pass freely away and do no harm. Many brass melters are beginning to question the advisability of using charcoal and other carbonaceous materials in closed furnaces, as the gases may be driven into, or absorbed by the metal and thus produce porous castings.

As glass makes a good covering, though a sticky one, it sometimes is used. A mixture 80 per cent sharp sand, 10 per cent each of soda ash and lime probably is better. The proportions of alkali can be varied to suit the degree of fusibility desired. A thinly-fluid slag in the furnace will pour with the metal into the ladle, then it can be stiffened by sand, and skimmed off or pushed back. A mixture of fluor spar and lime also is used, and is good; but fluor spar alone will attack the lining of the furnace. This should be used only to clean the lining or slag after the heats are done, and then not oftener than becomes necessary. A slag or flux, as nearly neutral as is possible, a glass, also should be used in the electric furnace; but not to protect the metal from oxidation, since the furnace is closed and the atmosphere is not strongly oxidizing. The covering should be used to protect the metal from the oxides of carbon generated from the electrodes. Care should be exercised to see that pressure is not built up in the furnace. What is desired is to keep out the external air, but not to do so at the expense of carbonating the metal, using the word carbonating in the same sense as is applied to carbonated waters. In the latter case all that is required is to place the water and the gas under pressure in a closed vessel and agitate; when the gas is taken up and held as long as the pressure remains. In the case of metal, enough of the gas may be retained after solidification to produce aerated castings. In fact, that it does this is well known. That is why additions of *deoxidizers* so frequently fail to give sound castings. A thinly fluid slag, and hot metal in the electric furnace as in other furnaces is a combination that will ensure sound, dense castings.

Anyone who has melted down brass residues such as sweepings containing sand, and probably oxides, will have noted the sharp running, clean metal that folows a high temperature and a thinly fluid slag.

Armature Bushings Show Submerged Pits

We are making armature bushings using 50 per cent scrap of the same composition and 50 per cent of new metal, the composition of the alloy being, copper 75 per cent; tin, 10 per cent, and lead, 15 per cent. We have experienced considerable trouble due to blowholes and small pits under the skin of the castings, which do not appear until machine work has been done. We are sending a sample for your inspection. We melt the metal in crucibles in natural draft furnaces fired with bituminous coal, and we keep the metal well covered with charcoal. The castings weigh from 20 to 50 pounds, and as there may be some question about the sand we use, a sample also is sent. We will appreciate any suggestions you may be able to offer.

The large holes appear to be coated with a film of sulphide from which we note that a flux of borax, calcium chloride, and calcium sulphate is being used in melting. As there is plenty of charcoal present, this reduces the sulphate to sulphide and from the sulphide it is possible, that at the temperatures reached some sulphur is liberated. We suggest the abandonment of this flux. Plaster of Paris with a little borax will work no harm.

The molding sand is too fine for castings of the weight named. A No. 2 Albany grade would be better. The core should be made with strong core irons as we note it has sprung or bowed upwards considerably. Use a core largely made of sharp sand, and coat it with plumbago wash creamed with molasses water. Dry the cores thoroughly. When melting the metal, continue the use of charcoal for crucible melting. Also in the case of a high lead alloy, about 1 per cent mixture of calcium sulphate with about 5 per cent borax, and 25 per cent soda ash is a good flux. It helps to hold in the lead. The calcium chloride should be omitted in this mixture. It is a good flux in moderation for ordinary red metals, but it should be used alone, or in connection with charcoal, in crucible melting.

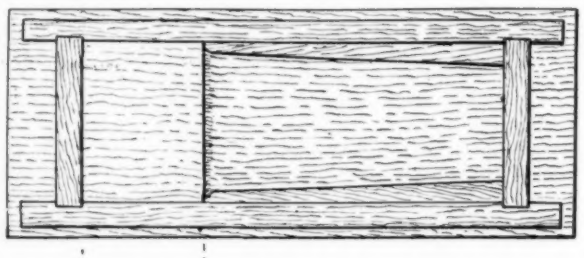
Iron Molds for Brass or Bronze

We are casting circular bars, 5/16 to 2 inches diameter and 4½ inches long. At present we are making these in sand molds, but wish to use iron molds. We have absolutely no data on this subject, and will appreciate any information you may be able to give us relative thereto.

We believe that the use of metal molds for castings of the kind mentioned will never justify the expense of such equipment in competition with machine-made, sand molds. If the metal used is bronze or red brass, while we would not state it cannot be done, it is nevertheless a problem we have so far failed to solve, although much time and money has been expended in the effort.

Yellow brass can be cast in iron molds and large quantities of bars have been made within recent years. With this alloy it would be wise to make the bars as long as possible, then cut them to size. If the use of aluminum bronze is contemplated the castings can be *die cast*, but to get commercial production it will be necessary to have machines to operate the dies as the latter have to be opened and shut with certainty and rapidity. However, cast iron will not make an ideal die material, or one that will last long. Aluminum bronze castings have to be bottom poured to avoid the formation of dross in the castings.

Bars of yellow brass of the approximate composition, 60 per cent copper, 40 per cent zinc, can be made in iron molds several feet in length. The molds resemble core boxes, and usually they are wiped with lard oil and the brass is top poured. A little experimental work will determine how best to proceed.



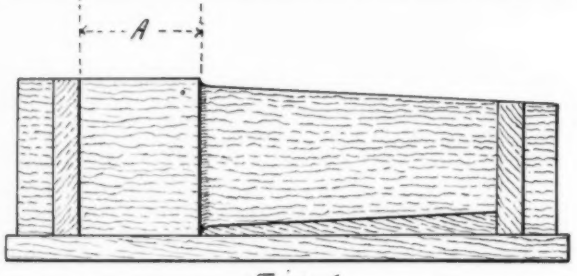


Fig. 1

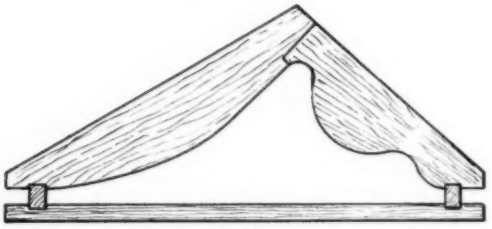


Fig. 4

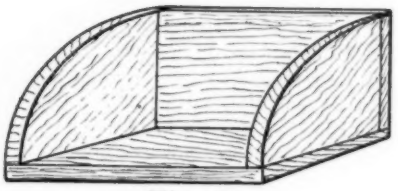


Fig. 5

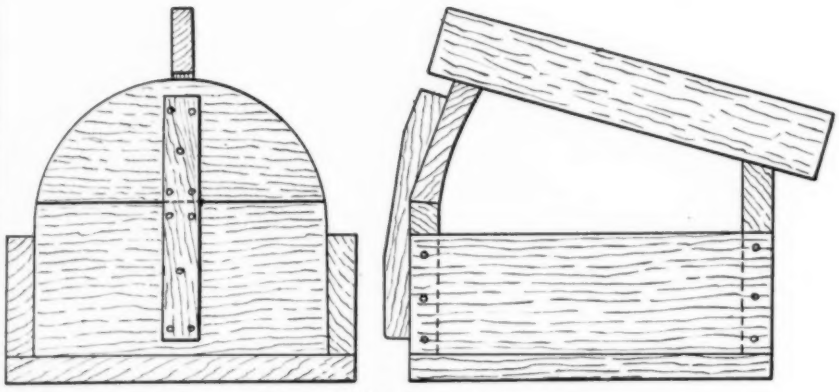


Fig. 2

Fig. 6

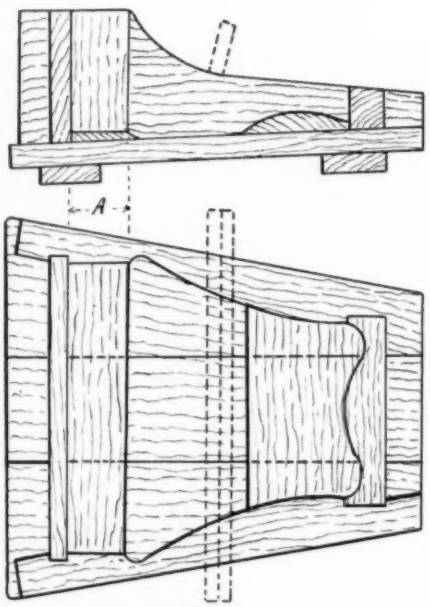


Fig. 3

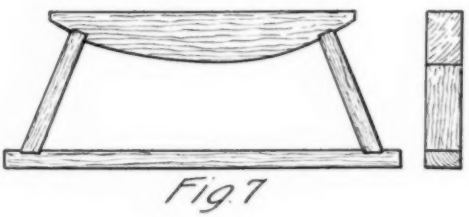


Fig. 7

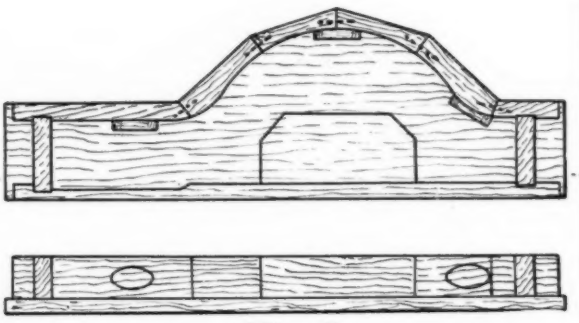


Fig. 8

FIGS. 1 TO 8 ILLUSTRATE TYPICAL FRAMED COREBOXES IN WHICH EITHER THE SIDES OR ENDS OR BOTH ARE DETACHABLE AND IN WHICH PART OF THE CORE SURFACE IS FORMED BY A STRIKE GUIDED OVER THE TOP EDGES OF THE COREBOX

Construction of Coreboxes--I

The Only Method in Some Cases and Alternative Methods in Others Are Described for the Construction of Coreboxes Which Present Features More or Less Out of the Ordinary

BY JOSEPH HORNER

FULLY as much detail is involved in the construction of coreboxes as is required in the patterns of which they form a complementary part. The same questions of delivery and economies in construction are common to both. The utmost care is taken with standard work, while makeshift methods are adopted for occasional jobs. The cost of lumber, often is heavy, but a considerable amount usually may be saved by prudent design. The box must retain its permanence of form to insure uniformity and accuracy in the shape of the cores. In the present instance, no attention shall be paid to the common form of boxes, round, square or drop prints. Instead, examples have been selected which illustrate some of the more elaborate and involved form—boxes which generally comprise an outer frame and a a set of interior fittings.

The example shown in Fig. 1 may be regarded as typical of this class of corebox construction. It includes ends and sides provided with rebated grooves and the various parts are held together during the ramming process by either screws or clamps. On long boxes, ribs or rods are provided to prevent distortion of the sides owing to the ramming of the sand, but on comparatively short boxes this precaution is not necessary. The length *A* corresponds with the coreprint on the pattern. It is made long because the core will have no other support save that afforded by two chaplets, one on the top and the other on the bottom, at the other end of the core. Bevelled pieces attached within the sides, and the formation of the frame top and bottom impart the necessary taper to the core. In this instance the core is destined to form a socket in a casting to receive the end of a building timber. A bottom board on which the frame is doweled is employed on account of the bottom taper. The bottom taper piece goes on the bottom board, otherwise the box could be set directly on the core bench. The taper at the top is imparted by a strike which follows the tapered sides of the frame. This feature is common to many coreboxes.

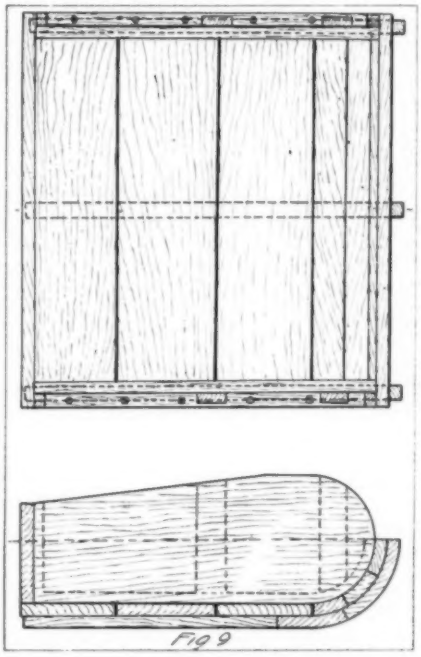


FIG. 9—COREBOX FOR SURFACE CONDENSER

Bottom Board Helps

No economical alternative has been presented to the method shown in Fig. 2. It avoids planing through deeply curved pieces of lumber by substituting a strike guided by the curved upper edges of the box ends. One end of the box where the shape is preserved with a batten, is curved inward. It is essential that the plane sides be carried up to the commencement of the curves on the ends to prevent the sand from falling away during the ramming process. After the sand is rammed, the ends and sides are unscrewed and removed, leaving the core standing on its bottom board. The bottom board is not an actual necessity, but the sides and ends are doweled to it and therefore prevented from being rammed askew.

The corebox shown in Fig. 3 re-

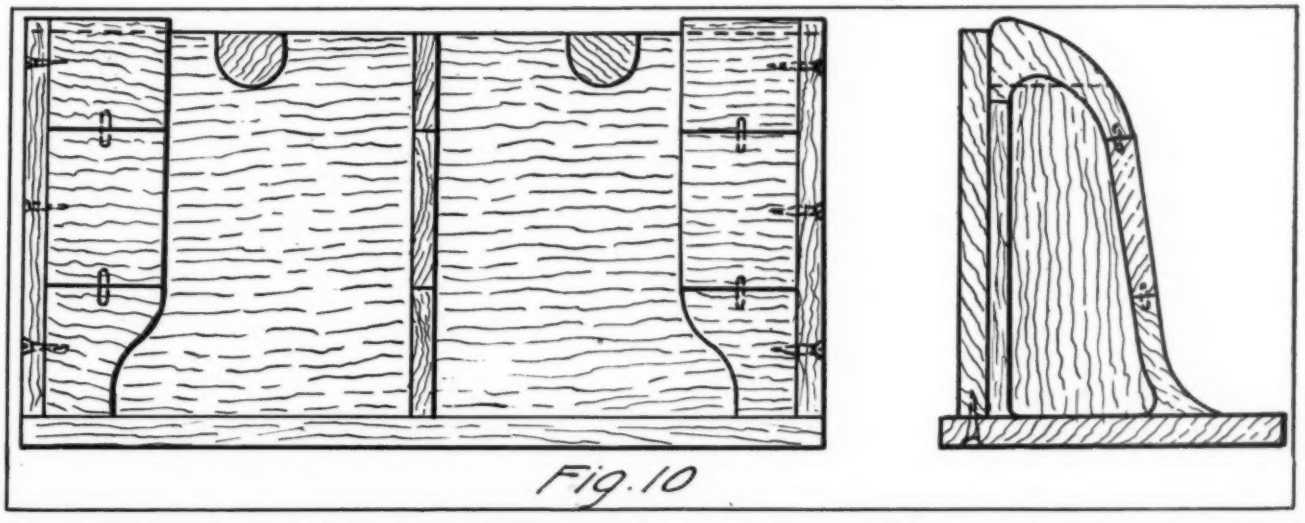


FIG. 10—THE PIECES THAT COVER THE RECESSED PORTION ARE GLUED TOGETHER AND SECURED WITH TIGHTLY FITTING DOWELS

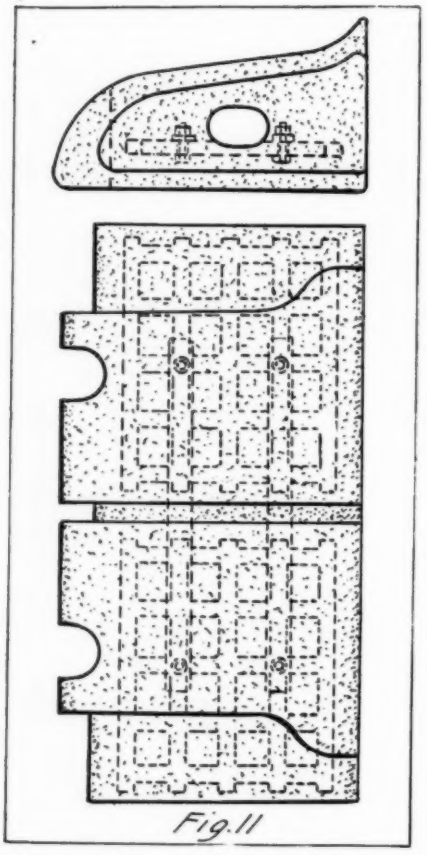


FIG. 11—THE CORE MADE IN THE CORE-BOX SHOWN IN FIG. 10

quires a bottom board because the two pieces shown attached to it require to be supported. This board, of large dimensions, is made with open joints in the same manner as large plated patterns. The various component parts are secured and held true with suitable battens. The top curved edges serve as a guide to the strike which imparts the required shape to that surface of the core. The two sides and one end are cut to curves done in the solid stuff. In this case it is not necessary to dowel the box frame to the bottom board, since the edges of the two cross pieces furnish a guide. In this corebox the part marked *A* corresponds to the thickness of the core print. So far as we know there is no alternative method, less expensive than that shown.

The example presented in Fig. 4 is that of a corebox for the crankshaft bearing of an engine bed, typical of many similar forms. The sides are plain and therefore no bottom board is required. It might be made with plain sides and bottom with the curved outlines cut on the top edges of the sides to serve as a guide for a strike. There is little to choose between the two methods, but that shown in Fig. 4 usually is employed. The box shown in Fig. 6 is plain with the top outlines cut to a curve to guide a strike. To make a box of that character, with a solid piece planed to the curve would be wasteful of time and lumber and wholly unnecessary.

Another corebox with edges curved to guide a strike is shown in Fig. 5. It is apparent that the use of solid stuff for the curved part would repre-

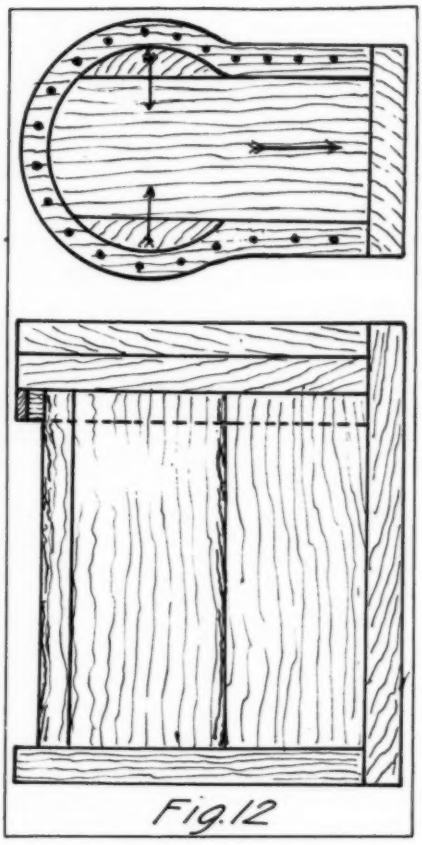


FIG. 12—JACKET FOR A SMALL CYLINDER

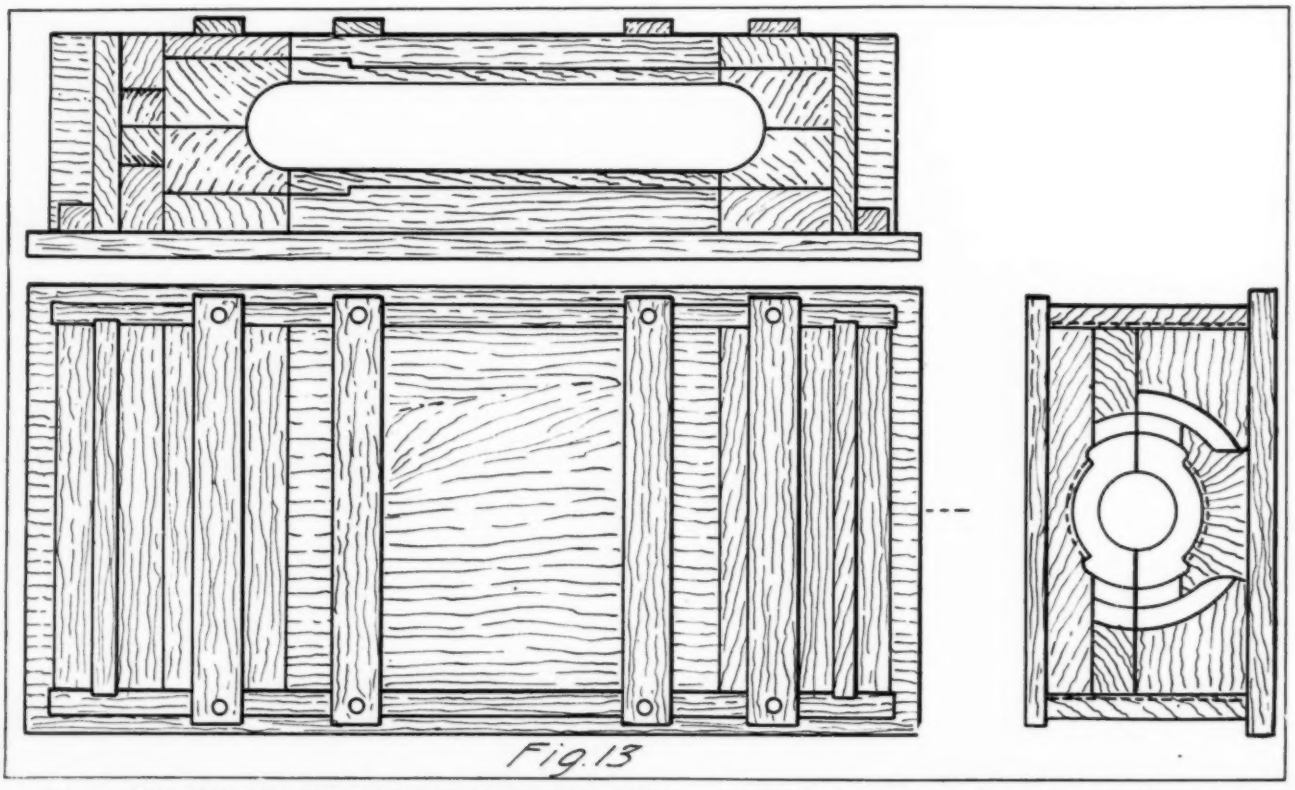


FIG. 13—COREBOX FOR CYLINDRICAL GUIDE FOR ENGINE CROSSHEAD—THE GUIDE BLOCKS ARE DIVIDED HORIZONTALLY DOWN THE CENTER

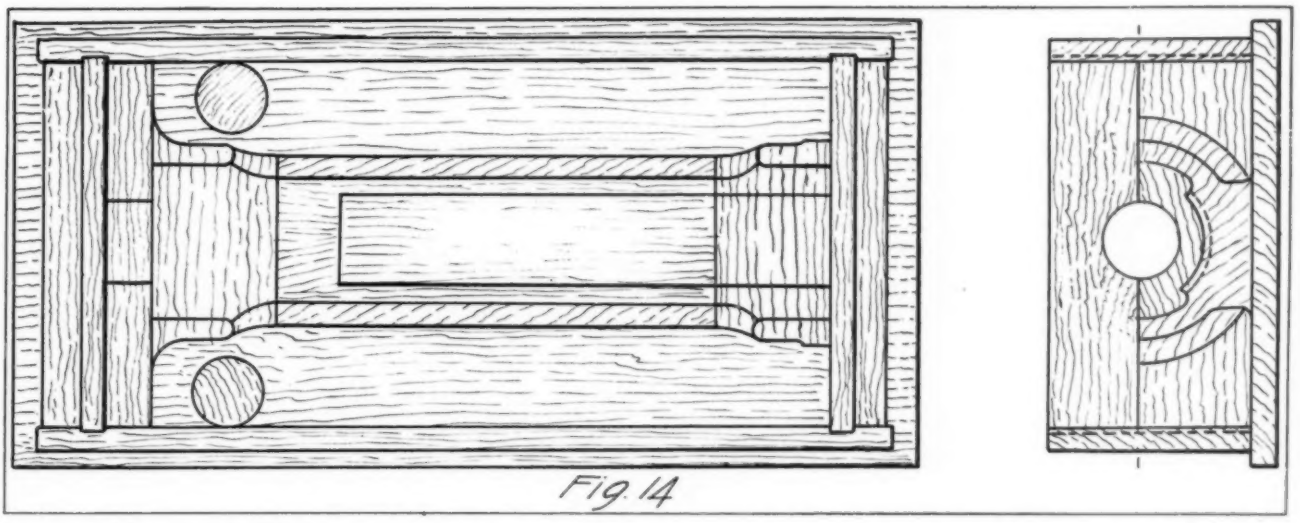


FIG. 14—THE SAME COREBOX AS THAT IN FIG. 13 WITH THE UPPER BLOCKS REMOVED TO SHOW THE INTERIOR

sent a waste of lumber. The ends and back are screwed together and doweled to a bottom board to prevent the ends from being rammed outward. The core made in this box is only used as a lightening core and therefore the box may be given considerable taper to facilitate the removal of the core. As an alternative method, the ends may be unscrewed and detached from the back and then drawn away from the core. Fig. 7 is a segmental box from which a ring core is built up in sections. Where the work is of a repetitive character it is better to cut the curve in the lumber, rather than providing deep sides and a strike. No bottom board is required. The ends are rebated into the sides and secured with screws.

In the type of corebox shown in Fig. 8 it is better on the whole to cut the curve outline in the block rather than employ a strike to form the curved surface. If the box was made with sides having the top edges cut to the curved outlines the three core prints would have to be carried on strips extending from one curved edge to the other. In addition a bottom board would be required to carry the block designed to provide metal under the bearing. Neither method has any great advantage over the other. The bottom board shown in the illustration is not essential, since the box frame might be laid on a plate or the bench, but where the frame is doweled to the bottom plate the arrangement prevents the frame from being rammed out of shape. Instead of cutting the curves in long pieces which will shrink, it is better to cut them in short lengths. Probably the best way to build up the curved section would be to form it in three or four courses of segments. However, the blocks may be attached to each other with dowels as indicated, or half lap joints may be employed.

An example of a corebox for a large surface condenser is shown in Fig. 9. The bottom board, necessary in this case, includes a curved portion. The remainder of the curve is formed with a strike. On account of its size the bottom board is made with strips and open joints, battened at the back to maintain them in proper position. The box ends are not rebated, but are prevented from being rammed outward by the strips shown which are fitted to lie against them. The strips are fastened to the longitudinal pieces. The box in Fig. 10 is deeply recessed to the outlines shown in the rear view, while the outer curves are struck from the guidance afforded by the edges of the box. To assist in elucidating the outlines the core is shown in Fig. 11, standing in the position for insertion in the mold. The pieces that cover the recessed portion are glued together and further secured with tightly fitting dowels. A bottom board, back and ends are screwed together and the other parts are unscrewed before the box is removed from the core. The arbor or grating employed to reinforce the core is outlined in Fig. 11. It is in two parts, bolted together with straps and is designed to be drawn out endways by the men in the cleaning department. The vent opening at the end of the core also is shown.

Another box for a strickled core, in this case for the jacket of a small cylinder, is shown in Fig. 12. The sand forming the core occupies the space between the central block and the outer edges which guide the strike. Two pieces indicated by the arrows have to be left loose on the central block to permit of their withdrawal from the core after the removal of

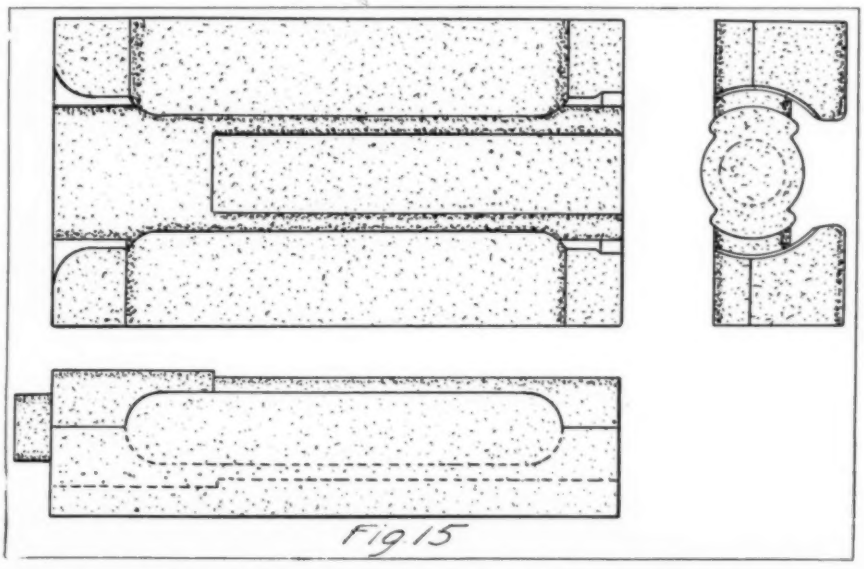


FIG. 15—THE CORE MADE IN THE COREBOX SHOWN IN FIGS. 13 AND 14

the main body. Ramming this core is a slow and troublesome process on account of the lack of support on the outer face. A certain amount of assistance is rendered by the rods inserted through the holes shown and also by the sand employed which is stiff and coherent. In the event that large numbers are required it would be better to avoid strickling and ram the core between outer and inner walls. The outer wall could be removed before withdrawing the box from the core. However, many cores have been made in the type of box shown.

A corebox with many parts, recognizable as that for the cylindrical guide for an engine crosshead is shown in Fig. 13. The outer frame is located with end strips on a bottom board. It is provided with sides and ends rebated into place. The framing enclosed the guide blocks, divided horizontally down the center to facilitate delivery. The lower half rests on the bottom board, the upper half is attached to battens doweled on the top edge of the framing. Four of these battens are provided, two for the parallel cylindrical portion and one each for the end blocks where the openings at the ends terminate in semicircles. The width of the casting terminates at the outside of the guides. The remainder of the width occupies core prints, one on each side running the whole length of the guide. The manner of fitting the different sections is indicated by the joint lines and also by the shade lines. To render the construction still clearer the box is shown open in Fig. 14, with the upper blocks removed, showing the interior. Fig. 15 illustrates the core. A comparison of these views will show the difference between the upper and lower halves of the box and core. The core fills the print impressions along the sides as high as the longitudinal center where it becomes a plane. Above the center, the print and core present the same contour as the openings through the guide as seen in the side view of Fig. 15.

Plan Cleveland Program

THE papers committee of the American Foundrymen's association has arranged for the Cleveland convention, April 28 to May 3, what promises to be one of the most interesting and well balanced technical programs ever presented under the auspices of that society. Following the custom of past years, sessions are being arranged to cover each branch of the foundry industry and as special features group meetings on molding sand research, apprentice training and special developments in the foundry world will be held. The Institution of British Foundrymen will submit a paper on British Foundry Practice, Ferrous and Nonferrous, written by Dr. Percy Longmuir, one of the leading foundry authorities of Great Britain, whose standing is affirmed by his recent appointment as chairman of the British Cast Iron Research association. The French association, known as the Association Technique de Fonderie de Francaise also will be represented, though their representative has not been chosen as yet.

The tentative schedule is given as follows:

Saturday, April 28

Opening of exhibits and registration.

Monday, April 30

Morning, Registration.

1:30 p. m. (a) Nonferrous session on aluminum foundry topics.

(b) Steel foundry session.

(c) Gray iron foundry session.

Tuesday, May 1

9:00 a. m. (a) Industrial relations. Symposium on training foundry workers.

(b) Nonferrous session on brass foundry topics. Joint sessions of American Foundrymen's association and American Institute of Mining and Metallurgical Engineers.

(c) Steel foundry session.

1:30 p. m. Sand research session on testing sands.

Wednesday, May 2

9:00 a. m. Sand research session on reclaiming used foundry sands.

1:30 p. m. (a) Malleable cast iron session.

(b) New developments in the foundry industry.

7:00 p. m. Annual Banquet.

Thursday, May 3

9:30 a. m. (a) Malleable cast iron session.

(b) Gray iron session.

(c) Final business meeting.

The sessions on molding sand research will be largely given over to committee reports of the joint American Foundrymen's association and Nation Research council committee on foundry sand investigation. As this investigation has been actively conducted since the Rochester meeting it is expected that many reports of the greatest value to all foundrymen will be brought out as the result of the work of the three sub-committees on sand testing, reclamation and conservation, and on geological survey.

The aluminum foundry session initiated at the 1922 convention proved such a success that it is to be continued because of the rapid development and increasing importance of this branch of the industry. The training of foundry workers is to be emphasized by the committee on industrial education as it is felt that ths important foundry problem will have to be given more attention than in the past few years to supply the need for trained foremen and supervisors.

A partial list of technical papers and their authors follows:

Aluminum Casting Alloys, Robert J. Anderson, Bureau of Mines, Pittsburgh; Melting Aluminum Alloys in the Electric Furnace, T. F. Bailey, Electric Furnace Co., Salem, O.; Casting Aluminum Radiator Fronts, Joseph Greves, Alloy Foundry Machine Corp., New Rochelle N. Y.; British Foundry Practice, Ferrous and Nonferrous, Dr. Percy Longmuir, Institution of British Foundrymen; Automotive Casting Practice, H. B. Swan, Cadillac Motor Car Co., Detroit; Carbon in Cast Iron, J. W. Bolton, Niles Tool Works Co., Hamilton, O.; Relation Between Plant Layout and Plant Cost, L. M. Hansen, Chicago; Comparison of Brass Melted in Open Flame, Crucible and Electric Furnace, Mr. Romanoff, Ohio Brass Co., Mansfield, O.; Casting Bronze Tablets in a Commercial Foundry, Jacob G. Kasjens, Brass Foundry Co., Peoria, Ill.; Open Hearth Practice, M. W. Carruthers, Westinghouse Electric & Mfg. Co., East Pittsburgh; Investigation of Core Sands, C. S. Koch, Fort Pitt Steel Casting Co., McKeesport, Pa.; Data on Re-use of Spent Molding Sand, F. L. Wolf and A. A. Grubb; Ohio Brass Co., Mansfield, O.; Use of Oil as Fuel in Malleable Furnaces, A. V. Landschoot, Iowa Malleable Iron Co., Fairfield, Ia.; Hardening Malleable Castings, Edwin K. Smith, Lake Side Malleable Iron Co., Racine, Wis.; The Tunnel Kiln in Annealing Malleable Castings, Philip Dressler, American Dressler Tunnel Kilns, Inc., Cleveland; Pyrometers in Malleable Foundries, H. Brewer; Leeds & Northrup Co., Chicago; Data on Powdered Coal, F. L. Wolf and W. Arrowood, Ohio Brass Co., Mansfield, O.; Handling Scrap in a Malleable Plant, E. D. Halsey, Terre Haute Malleable & Mfg. Co., Terre Haute, Ind.; Centrifugal Casting, Leon Cammen, New York; Electric Grey Iron Casting, L. J. Barton, Los Angeles, Cal.

Completes Half Century of Foundry Service

FIFTY years continuous service to the foundry industry is a distinction that can be claimed by a comparatively small number of men and those who continue actively engaged in the industry after such a long period are comparatively fewer still. In February of this year 1923 David McLain, originator and active head of McLain's System, Milwaukee, celebrated the fiftieth anniversary of his entry into the foundry when as a boy less than 10 years of age he commenced his carreer as an embryo molder by twisting hay rope for core barrels in the old Smith pipe foundry in Pittsburgh.

Even at that time Pittsburgh was regarded as an important foundry center, a distinction maintained and fostered in succeeding years by the establishment and expansion of the great iron and steel plants and other forms of industrial enterprise that have placed the city in the front rank of the great manufacturing cities of the world. The practical application of many of the important and epoch making inventions and discoveries that make up modern foundry practice first were tried in the Pittsburgh district and through his intimate connection in those early days and succeeding years, Mr. McLain laid the foundation of the comprehensive knowledge of the subject that has characterized his work in recent years as a foundry consultant. He was born in Belfast, Ireland, Nov. 11, 1863, of Scotch and Irish parentage and with other members of the family emigrated to the United States in 1868 and settled in Pittsburgh, at that time recognized as a desirable terminal for large numbers of skilled, semiskilled and common labor from the British Isles. He attended school for a few years until forced by economic conditions incident to the panic of 1873 to do his little bit toward the support of the family. After completing his apprenticeship he worked in several foundries in the city and from 1878 to 1883 worked as a molder in the first successful crucible steel foundry in the United States. In 1883 at the age of 20 he married and three years later, partly as a natural result to such a spur to his ambition he secured a position as foreman of the first bessemer converter steel foundry in the country. He remained in this position several years and did his share in the gradual evolution of the steel casting business from the crucible and converter processes dependent on a restricted class of raw materials, with limited sulphur and phosphorus allowances. Mr. McLain operated a crucible steel foundry in Milwaukee and from 1900 to 1904 served as superintendent of the iron, steel and brass foundries of the Christenson Engineering Co., now the National Brake & Electric Co., Milwaukee, where he carried on and completed his experiments in using large quantities of steel scrap in the cupola charge. From 1904 to 1908 he traveled extensively in the capacity of foundry consultant and in the latter year decided to compile a course of lessons based on his extensive experience, in mixing iron, cupola practice and the manufacture of semisteel. The course was revised at various times, the seventh edition being published in 1922. In 1910 this course was supplemented by a course on steel foundry, embracing electric, converter, crucible and open hearth processes. In the summer and fall of 1922 Mr. McLain spent five months in Great Britain and parts of continental Europe studying foundry conditions and meeting personally many of the foundrymen who had built up their practice in accordance with his advice.

DAVID McLAIN

THE FOUNDRY

Registered U. S. Patent Office

A semimonthly journal devoted to all branches of the foundry trade

Published by
THE PENTON PUBLISHING CO., CLEVELAND, O.

BRANCH OFFICES

BOSTON.....426 Old South Bldg.
CHICAGO.....1147 People's Gas Bldg.
CINCINNATI.....504 Edwards Bldg.
NEW YORK.....2203-2206 No. 220 Broadway
PITTSBURGH.....2148-49 Oliver Bldg.
SAN FRANCISCO.....675 Monadnock Bldg.
WASHINGTON, D. C.....84 Home Life Bldg.

FOREIGN OFFICES

BIRMINGHAM, ENGLAND.....Prince's Chambers
LONDON, ENGLAND.2-3 Caxton House, Westminster, S.W. 1
PARIS, FRANCE.....224 Rue de Rivoli
Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....£1:0:0 a year
Single Copies.....25 cents
Copies published three months or more previous to date of current issue, 50 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulations, Associated Business Papers, Inc., and National Publishers Association
Entered at the Post Office at Cleveland as Second Class Matter

Copyright 1923 by The Penton Publishing Co.

Contents

	Page
Bronze Towers Guard Avenue	127
Iron for Grinder Plates	130
Compares Molding Practices	131
Boiler Company Buys Plant	135
Gives Points on Die Casting	136
Form New Pipe Company	137
Studies Effect on Steel of Manganese	137
Study Pouring Temperatures	138
Book Review	140
Figures for Nonferrous Metals Show Loss	140
To Specialize on Monel Metal Castings	140
Incorporates Foundry	140
Installing Conveyors	140
Heats Patterns Electrically	141
Report on Molding Sand Production	143
Steel Castings Output Large in 1922	143
Introduces Jointless Furnace Lining	143
Plant Gets New Name	143
Book Review	143
Buys Collinwood Plant	143
Organizes New Company	143
Bell Output Decreases	143
Joins Coke Sales Force	143
Bill on Repairing Broken Castings—III	144
Organize for Taking Inventory	147
Equipment Depends Upon Potential Market	149
Improves Malleable Anneal	150
Hot Iron Required for Light Castings	151
Select Sand for Brasswork—I	152
How and Why in Brass Founding	154
Metal to Resist Acid	154
Coverings for Use in the Melting of Brass	155
Armature Bushings Show Submerged Pits	155
Iron Molds for Brass or Bronze	155
Construction of Coreboxes—I	157
Plan Cleveland Program	160
Completes Half Century of Foundry Service	161
Cupola Practice Not Standardized	162
Trade Outlook in the Foundry Industry	163
Comings and Goings of Foundrymen	164
Institute of Metals Meets	165
Discusses Sand Testing	165
A. F. A. Nominates	165
Sand Committee at Work	165
Machine Manufacturer Dies in Davenport	165
Obituary	165
Successfully Welds Heavy to Light Sections	166
Plugs and Taps Cupola	166
Equipment Activity Grows	167
What the Foundries are Doing	168

Cupola Practice Not Standardized

ABOUT three years ago when a combined steel, coal and railroad strike threatened to tie up the commercial affairs of the country, THE FOUNDRY sent a questionnaire to several hundred foundries asking them to indicate their coke requirements and also in a general way to describe their cupola practice covering such items as cupola diameter, size and number of tuyeres, amount of coke on bed and between charges, weight of iron on each charge and total amount melted each heat, blast pressure, class of castings, melting speed and possibly one or two further items. Replies to this questionnaire were tabulated, analyzed and published in THE FOUNDRY, Sept. 1, 1920. Replies were received from every class of foundry from the little shop casting one or two tons a week up to the great pipe and wheel shops that pour several hundred tons of iron a day. If there was one feature more than another emphasized by that questionnaire, it was the utter lack of uniformity in cupola practice prevailing even among foundrymen operating the same size cupola, melting the same amount of iron per day and pouring it into the same class of castings.

Research, study and original investigation on the general subject of foundry practice have been carried on to a considerable extent in recent years. The government bureau of standards, large firms and private individuals have devoted their time to developing and proving theories and to numerous experiments having for their object the discovery of the ideal condition under which a cupola should be operated most efficiently and economically. The results secured by these various investigations tally closely and indicate that satisfactory melting conditions hinge on three main factors. These are: A sufficient volume of air to consume a definite amount of coke in a given time; fixed relation between the coke and iron in the charge so that the layer of coke is completely consumed by the time the over laying charge of iron is completely melted; the addition of a sufficient quantity of a suitable fluxing agent that will unite with the ash from the coke and other impurities to form a liquid slag that will flow readily from the furnace.

The result of these investigations to a great extent have not been kept secret. On the contrary they have been disseminated freely through personal contact, through correspondence and through the columns of technical publications. Papers dealing with the subject have been presented before sectional organizations and before the annual conventions of the American Foundrymen's association. Information on cupola melting methods is on record and is available for a minimum of time and trouble to any person interested and yet a comparison of methods pursued in several foundries will show that standardization does not prevail along this line. Probably the majority of foundrymen at one time or another have heard or read of an improvement on their present practice, but have failed to take advantage of the knowledge. This attitude in some cases is due to apathy which always keeps putting off until tomorrow. In other cases it is due to a peculiar conservation which seems to prevail in the casting industry.

Trade Outlook in the Foundry Industry

FOUNDRY operations, judged from early indications, will show a steady increase and a larger total output in February than in the preceding month. Orders in many sections have increased to the point where larger manufacturing concerns operating their foundry departments are letting out work to jobbing shops, while the latter in turn are exceptionally busy. That a continuation of this state is expected, is shown by increased purchases of materials and supplies for future use and also by the demand for foundry equipment, which has shown a marked advance in the past month. Pig iron and coke are being sought for second quarter delivery.

All Classes Share

Jobbing foundries, particularly those making light and medium weight gray iron castings lead in activity at the present time. They are closely followed by the automotive production shops, which report an exceptionally heavy demand for the season of the year. Judging from the Detroit district alone, the prospects are most encouraging for a continued heavy output of automobile castings. The production of passenger automobiles alone in that city now runs well over 10,000 a day and dealers are in advance of the present production schedule. Employment in Detroit industries during January ran well ahead of the peak reached in 1920. According to the Employer's association, approximately 300,000 men are working in factories in that city. Although a slight decrease is noted in the purchases of railway cars and equipment, during the first week of February, the business on the books of manufacturers is bringing much work to the foundries. January registered 13,390 freight cars placed, compared with 23,255 for December. While the total is lower for last month, the number of buyers is greater and freight loadings are increasing.

Prices of Raw Material for Foundry Use

CORRECTED TO FEB. 7

Iron		Scrap	
No. 2 Foundry, Valley	$27.00 to 28.00	Heavy melting steel, Valley	$22.75 to 23.00
No. 2 Southern, Birmingham	24.00 to 25.00	Heavy melting steel Pitts.	23.50 to 24.00
No. 2 Foundry, Chicago	29.00 to 30.00	Heavy melting steel, Chicago	19.00 to 19.50
No. 2 Foundry, Philadelphia	28.76 to 29.13	Stove plate, Chicago	20.00 to 20.50
No. 2 Foundry, Buffalo	28.00	No. 1 cast, Chicago	25.75 to 26.25
Basic, Valley	25.50 to 27.00	No. 1 cast, Philadelphia	24.00 to 25.00
Basic Buffalo	28.00	No. 1 cast, Birmingham	20.00 to 21.00
Malleable, Chicago	28.00 to 29.50	No. 1 cast, Buffalo	24.00 to 25.00
Malleable, Buffalo	28.50	Car wheels, iron, Pittsburgh	24.50 to 25.00
Coke		Car wheels, iron, Chicago	26.00 to 26.50
Connellsville foundry, coke	$9.00 to 10.00	Railroad malleable, Chicago	26.00 to 26.50
Wise county foundry, coke	8.50 to 9.50	Agricultural mal., Chicago	26.00 to 26.50
		Malleable, Buffalo	23.00 to 23.50

Farm Buying Grows

At a meeting of the Mississippi Valley Implement, Vehicle and Hardware association held in St. Louis during the first week of February reports showed vastly improved conditions in farming districts. This is affecting all lines of manufacture indirectly and the implement trades in particular. Agricultural products show improvement over prewar prices, while high priced cotton has brought to the South more prosperity than it has experienced since the Civil War. Cast-iron pipe foundries in the South are busy, some to the point that plant extensions are being rushed through to enable them to meet the demand. Sales of pipe have been heavier in the smaller sizes and makers now are seeking large diameter work to balance their output. Municipalities are letting castings contracts in anticipation of spring construction work. The city of Boston recently awarded over 200 tons of miscellaneous work in addition to large pipe tonnages. Machine tool demand is looking up, though orders are scattered and for small lots. Foundries making castings for machine tool builders still lag behind in the general average of activity.

Buying Advances

Increased demand for pig iron is reflected in contracts for future delivery and in the anxiety to secure immediate delivery on present contracts. A slight stiffening in price is noted. Pig iron production registered another gain in January, according to statistics compiled by the *Iron Trade Review*. The total output was 3,266,065 tons while the preceding month showed 3,083,520 tons giving an increase of 142,545 tons to the credit of the first month of the year. During January, the daily average production was 104,066 tons per day, while December showed 99,468 tons, giving a gain of 4598 tons. Merchant pig iron production for January totaled 712,436 tons, while December showed an output of 668,950 tons. On a daily average basis, the difference of 1402 tons per day in the production of merchant pig iron was in favor of January with its 22,981 tons per day as against 21,579 tons per day for the preceding month. The total number of blast furnaces making merchant iron was 77 on Jan. 31 and 73 on the last day of December. Coke prices show a slight softening, and doubtless as the advance of spring relieves the pressure of demand for coal and coke for domestic use and as shipping conditions improve, lower prices may be expected.

Brass Shops Busy

Continuation of building construction even through the winter months has maintained a steady demand for plumbers' brass goods. Futher, the automobile and railway requirements have been heavy and have served to support a high rate in nonferrous foundry operations. New York prices on nonferrous metals, according to the *Daily Metal Trade* of Feb. 8 follow: Casting copper, 14.55c to 14.62½c; electrolytic copper, 15.00c to 15.12½c; Straits tin, 40.37½c; lead, 8.00c to 8.20c; antimony, 7,12½c ;aluminum, No. 12 alloy, open market, 21.50c. Zinc is 7.07½c to 7.10c, E. St. Louis, Ill. Prices showed a slight advance in January. The monthly average prices follow:

(New York Quotations)

Casting Copper	Electrol Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
14.302	14.784	7.844	39.182	6.786	22.807	6.956

Comings and Goings of Foundrymen

PERCIVAL CHRISTIE has been elected to the office of president of the Taylor-Wharton Iron & Steel Co., High Bridge, N. J., to succeed the late Knox Taylor. Mr. Christie was formerly vice president and has been acting president since Mr. Taylor's death. He started to work for the company as office boy during his school vacations. Going into the shops he progressed through various departments until he became inspector. Then he went into the sales and introduced the use of manganese steel in the anthracite coal regions of Pennsylvania. Returning to the plant he worked up to superintendent of the steel foundry, then secretary and treasurer, and finally vice president, a position he held for many years. As president of the Taylor-Wharton Iron & Steel Co., he is also president of its subsidiaries, the William Wharton, Jr., & Co., Inc., Easton, Pa. and the Tioga Steel & Iron Co., and the Philadelphia Roll & Machine Co., Philadelphia.

James H. Anderson has been made foundry superintendent for Sweet & Doyle, Green Island, N. Y.

H. R. Linton has resigned as manager of the Athol Foundry & Machine Co., Athol, Mass., and is succeeded by Mr. Kessler.

John Poczesny has been appointed foundry superintendent of the Eagle Foundry Co., Muskegon, Mich.

Dr. Homer Gage, president of the Crompton & Knowles Loom Works, Worcester, Mass., plans to leave next month on a European trip.

George C. Stone, treasurer of the Clinton Foundry Co., Clinton, Mass., has been elected a director of the Clinton Trust Co.

William G. Abbot, formerly in charge of the statistical department of the Consolidated Steel Corp., New York, has been appointed research director of the National Foreign Trade council, New York.

Donald Clute, formerly a member of the sales organization of the Cadillac Machinery Co., Detroit, has been placed in charge of the Detroit office of the Oilgear Co., Milwaukee, at 415 East Jefferson avenue, which was opened recently.

I. L. Houghton has been made vice president and general manager of the United States Malleable Iron Co., Toledo, O. Mr. Houghton was with this firm six years ago and since that time he has been identified with various interests including the Maumee Malleable Castings Co. which firm he organized and of which he was president. He has disposed of his holdings in the latter company.

John J. Corliss, for 27 years associated with the Adriance Platt Works of the Moline Plow Co., Poughkeepsie, N. Y., as core room foreman and later as foundry foreman, has resigned to accept a position with the Advance Boiler Co., Poughkeepsie.

J. L. Battenfeld, formerly connected with the U. S. Molding Machine Co., Cleveland, and more recently with the W. W. Sly Mfg. Co., Cleveland, has become associated with the molding machine division of Johnston & Jennings Co., of the same city.

Ted Martin, recently manager of the Maynard Steel Casting Co., and previously connected with the George H. Smith Steel Casting Co., both of Milwaukee, has been made manager of the Farrell-Cheek Steel Foundry Co., Sandusky, O.

John J. Corliss, for 27 years associated with the Adriance Platt Works of the Moline Plow Co., Poughkeepsie, N. Y., in the capacity of core room foreman and later foundry foreman, has resigned to accept a position with the Advance Boiler Co. of that city.

Thomas Stewart, formerly foundry superintendent of the Lakey Foundry & Machine Co., Clover Foundry, Muskegon Castings Co., all of Muskegon, Mich., and the Interstate Foundry Co., Cleveland, O., has been appointed superintendent of the Foster Machine Co., Elkhart, Ind.

H. M. Riddle, president the Asbury Graphite Mills, Asbury, N. J., sailed from New York Wednesday, Jan. 24, on the steamship SAMARIA on the first portion of a trip round the world. Mr. Riddle will visit the island of Ceylon with a view to making closer connections with the mniers of Ceylon plumbago.

Samuel M. Buck has been elected a director of the Taylor-Wharton Iron & Steel Co., High Bridge, N. J., to fill the unexpired term of Knox Taylor. Mr Buck is works manager of the High Bridge plant and of the William Wharton, Jr., & Co., plant at Easton, Pa. He was chosen to represent the employe stockholders.

W. E. Mills has been elected vice president and general manager of the Hadfield-Penfield Steel Co., Bucyrus, O. As general manager he succeeds R. C. Penfield who resigned that position. Mr. Penfield, did not sever his connection with the company, however, as in the future his activities will be devoted to the interests of the American Equipment Co., a subsidiary organization.

George S. Rowbotham, Frank A. Russ and James A. Gannon have been placed in charge of desiging, estimating and constructing of fabricated steel for the Montgomery Iron & Steel Co., Philadelphia. In addition to these appointments, L. R. Welsh has been placed in charge of similar work on all plain material and A. F. McCarty, of ornamental iron work, fire escapes and vault lights.

Norman Russel has recently been elected vice president of the New England Foundrymen's association, and therefore, is in line for the presidency in 1924. He is president of Albert Russell & Sons Co., Newburyport, Mass., manufacturers of pumps, capstans, and steam and hot water heating systems. Mr. Russell was born in Newburyport in 1884 and graduated from Dartmouth college in 1906. In October of the same year he entered the employment of the firm with which he is now connected.

Christian W. Lynch has been elected president and a director of the Harrisburg Pipe & Pipe Bending Co., Harrisburg, Pa., to fill the vacancy caused through the resignation of Alfred K. Barker. Up to last year Mr. Lynch was president and general manager of the Harrisburg Foundry & Machine Co., Harrisburg, Pa., and prior to that for many years was president and geneal manager of the W. O. Hickok Mfg. Co., Harrisburg.

M. Kessler has been appointed general manager of the Athol Machine & Foundry Co., Athol, Mass., to succeed H. R. Linton. Mr. Kessler has had an extensive machine shop experience. Previous to 1914 he was general foreman of the machine shop of A. E. Meyers Co., Pittsburgh. When this company was sold to the Standard Steel Car Co. in 1915 he remained with the new company in the position of superintendent, and under his direction the plant produced 50 Vim motors per day. The latter part of 1915 he went to the Westinghouse Electrical Manufacturing Co., Pittsburgh, as general foreman of a department producing 8-inch British shells. Later he was placed in charge of the production of moveable parts for the Browning

machine gun at Springfield, Mass. In 1919 he accepted a position as general superintendent of the company in Athol with which he is still connected. This company makes a specialty of vices, grindstone frames and hardware specialties.

Institute of Metals Meets

The annual meeting of the British Institute of Metals will be held at the Institution of Mechanical Engineers, London, March 7 and 8. The annual dinner will be held at the Trocadero restaurant Wednesday evening, March 7. The meeting is expected to be of an especially interesting character and more papers will be presented than at any previous assembly of the institute.

Discusses Sand Testing

Keeping open house in the winter garden of the LeClaire hotel, Moline, Ill., the Quad City Foundrymen's association considered the question of molding sand at its January meeting. The speaker was Eugene W. Smith, of the Crane Co., Chicago, who presented his exhibit of sand samples separated by his new vibratory method of precipitation, as he had previously done before the Chicago Foundrymen's club. Samples of sand submitted at the meeting were precipitated by Mr. Smith and discussion of the value of his method occupied more than an hour.

A. F. A. Nominates

At a meeting of the nominating committee of the American Foundrymen's association held Tuesday, Jan. 23, at the Cleveland Athletic club, Cleveland, the following nominations were made: For president to serve for one year, G. H. Clamer, Ajax Metal Co., Philadelphia; for vice-president, to serve for one year, H. B. Swan, Cadillac Motor Car Co., Detroit; for directors to serve three year terms each, L. L. Anthes, Anthes Foundry, Ltd., Toronto, Ont., T. S. Hammond, Whiting Corp. Harvey, Ill., Alfred E. Howell, Sommerville Stove Works, Sommerville, N. J., C. R. Messinger, Chain Belt Co., Milwaukee, Wis., Thomas W. Pangborn, Pangborn Corp., Hagerstown, Md.

Sand Committee at Work

Many firms, universities, governmental departments and individuals are co-operating in the work of the committee on molding sand research, under the guidance of the division of engineering of the National Research council and American Foundrymen's association.

The subcommittee on geological surveys has prepared for the use of the state geological surveys, standard methods of making surveys of molding sand resources and preparing test samples. It is thought that excessive freight charges being paid by foundrymen to get sand from long distances may be avoided by making available deposits now undeveloped which are near at hand. The states of Illinois, Virginia, Maryland, Alabama, Florida, Pennsylvania, Tennessee and New Jersey, are already co-operating.

The subcommittee on conservation and reclamation has mailed 7500 questionnaires to gray iron, nonferrous, steel and malleable foundries to obtain information on the proportions of sand reclaimed and

JOHN THEODORE ANDERSON

methods of reclamation. The Ohio Brass Co. is making investigations for the use of clay in retaining bond strength in molding sand heaps. The Sivyer Steel Casting Co., Milwaukee, is studying the effect of clay additions on the grain size of sand heaps. The American Steel Foundries, Chicago, has reported on the method and equipment designed and patented, which permits a recovery of about 70 per cent of refuse sand used in steel foundry work.

The process involves cleaning the sand grains of adhering fused material, then separating by air currents the good sand from the bad material.

Of the $15,000 called for in the budget for the next year, more than half has already been secured.

J. A. Doyle, furnace engineer of the W. S. Rockwell Co. spoke recently before the Connecticut section of the American Society of Mechanical Engineers at New Haven, Conn., on "Fuels for Industrial Heating Processes."

Machine Manufacturer Dies in Davenport

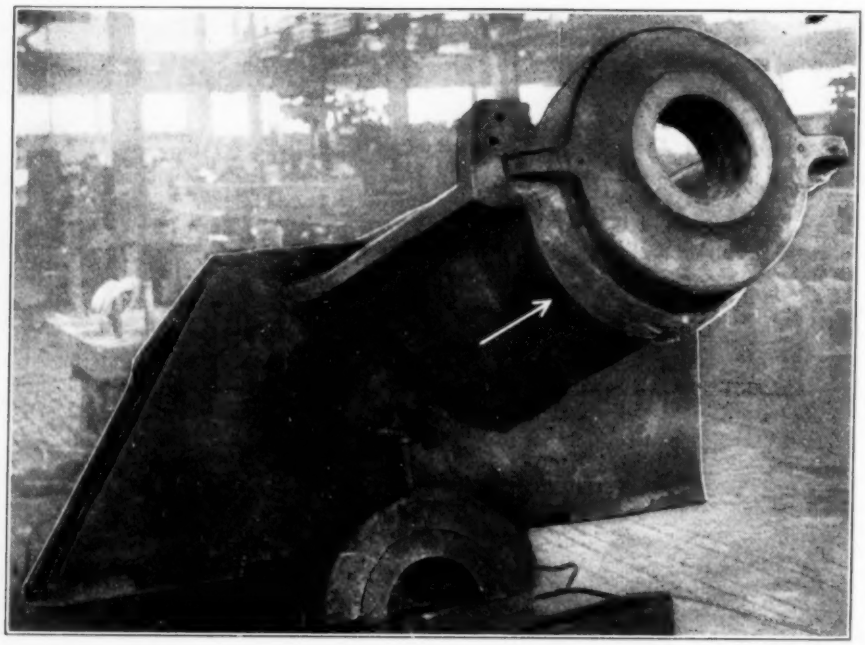
John Theodore Anderson, connected with the Davenport Machine & Foundry Co., Davenport, Iowa, for 32 years, during 25 of which he has served as superintendent and general manager, died at 1:30 p. m. Jan. 28 in Mercy hospital, Davenport after a short illness. One of the regrettable features connected with his unexpected death at the comparatively early age of 56 was that plans practically had been completed by the company for a celebration on April 25 in commemoration of the 25th anniversary of his elevation to the position of superintendent of the plant.

He was born in Christianople, Sweden, August 25, 1866 and as a young man of 18 came to the United States where he secured his first position and learned the machinist's trade in the shops of Barnard & Leas Co., Moline, Ill. After completing his apprenticeship he moved to Davenport and worked for the Bettendorf Axle Co., now the Bettendorf Co., for a short time. He entered the employment of the Davenport Machine & Foundry Co., 32 years ago and remained with that company since that time. Mr. Anderson was a member of the American Foundrymen's association, the Davenport and Rock Island Chambers of Commerce and several fraternal organizations. The funeral was held Wednesday Jan. 31 from the Davenport Elks' home. Surviving are his mother, Mrs. Anna Anderson; one brother, Albert and two sisters, Mrs. Mary Adolphson, Davenport and Mrs. Mathilda Anderson, Chicago.

Obituary

James J. McCarthy, who has been prominently identified in the railway supply business for many years, died on Saturday morning, Nov. 25, at his home in Chicago. Mr. McCarthy was one of the original organizers of the Independent Pneumatic Tool Co., and served as a director up to the time of his death. He also organized the Chicago-Cleveland Car Roofing Co. and took an active part in its business. Mr. McCarthy was past 80 years old when he died.

William P. Waugh, consulting engineer for the H. H. Robertson Co., Pittsburgh, died recently at his home in Sewickley, Pa. He was well known through his work in the development of skylights and the solution of ventilation problems in many of the country's greatest industrial plants and public buildings. He attended Iowa State college, and upon leaving school took up railroad construction work. From this he became connected in other



THE CASTING AS IT APPEARED AFTER THE WELD WAS COMPLETED

phases of construction work including the St. Louis water works tunnel under the Mississippi river and the construction of the Chicago drainage canal. For 12 years he was sales manager in the New York district for the James G. Wilson Mfg. Co., which position he left some time before joining the Robertson company.

Joseph P. Murphy, one of the owners of the Northampton Iron Works, Florence, Mass., iron foundry, died in a Boston hospital, following an operation, Jan. 5, aged 28 years. He had been employed in the foundry for several years and about a year ago, with David J. Lynch, purchased the business.

F. H. Wheeler, president, the F. H. Wheeler Mfg. Co., Chicago, makers of safety and protective wearing apparel died recently at his home in Chicago, aged 62. Mr. Wheeler had been engaged in this line of endeavor since 1911. He is succeeded by E. J. Wheeler who took up the active management of the firm two years ago.

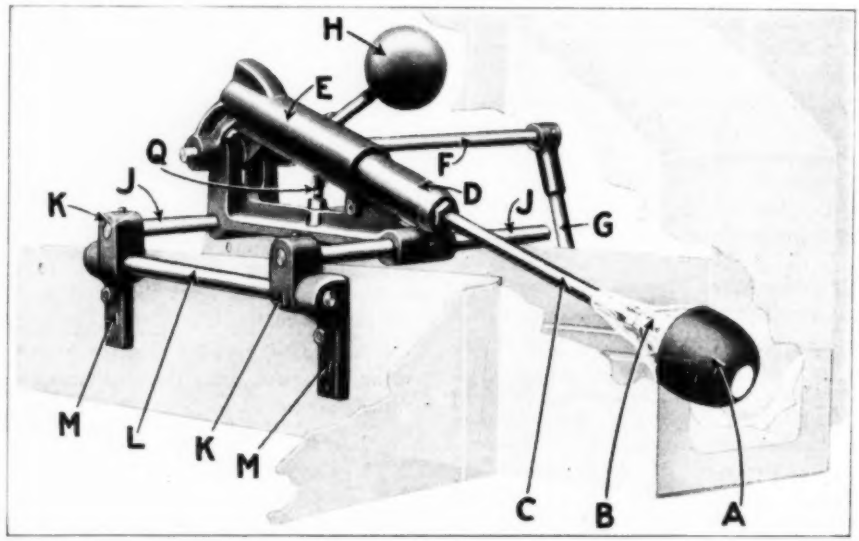
Successfully Welds Heavy to Light Sections

Complications due to the unequal thickness of the two sections involved formed part of the problem presented to operators connected with the Pittsburgh office of the Metal & Thermit corporation, 120 Broadway, New York, when requested to weld the cast iron piercing mill housing at the plant of the Seamless Tube Co., Ambridge, Pa. The head, with the exception of the opening in the center presented a solid 8-inch thickness of metal while the semicylindrical part of the casting to which the head originally was attached was only 3 inches thick. In preheating the casting preparatory to pouring the welding material the preheating flame was directly slightly toward the heavier section. In addition to placing a riser on each side of the weld on top a third riser was arranged in a suitable manner to lead up from the the lowest point of the semicylindrical section. This riser prevented trapping of gas in the weld and also served a useful purpose during the preheating process by furnishing a channel through which the torch was directed. The weld shown in the accompanying illustration was effected 24 hours after notice was received that the casting was broken, using 400 pounds of material.

Plugs and Taps Cupola

Claiming that the device is past the experimental stage, having been in actual operation in its own foundry for over a year, the Medart Co., St. Louis, has placed on the market a piece of equipment for stopping and tapping the cupola stream. The principle employed is the same as that in a bottom pour steel ladle and practically the only difference in the application lies in the fact that the stopper in a steel ladle operates vertically and the stopper shown in the accompanying illustration is mounted horizontally. Reference to the various letters on the diagram will make the description clearer. The ball *A* is made of a special refractory composition and fits closely in a corresponding recess in the breast. The recess is prepared by forcing the ball against the breast while the clay is still soft. In that manner an accurate and close fit is assured. A bolt extending through a suitable hole in the center serves to attach the ball to the cup *B* which in turn is threaded on to the piston rod *C*. After the stopper head is secured the cavity outside the head of the bolt is filled with fire clay.

The piston rod *C* is threaded into the piston *D* which moves backward and forward in the sleeve and frame *E*. The piston is attached through a pin and link at the rear to the shaft *F* which in turn is actuated by the lever *G*. An extension of any kind may be added to the lever *G* to meet local conditions so that the operator may stand at any convenient distance in front or to one side of the spout. The counterweight *H* holds the stopper either in open or closed position. The device may be attached to any spout.



THE MECHANICALLY OPERATED STOPPER IS MANIPULATED ON THE SAME PRINCIPLE AS THAT EMPLOYED FOR A SIMILAR PURPOSE IN A BOTTOM-POUR STEEL LADLE

Equipment Activity Grows

Marked Improvement in Foundry Operations Induces Purchases of Machinery Replacements, While Equipment Is Sought For Plant Extensions and New Construction Projects

SALES of foundry equipment continue to increase, and inquiries are the largest noted in many months. New shop construction again is a factor in the market, while improvements and additions serve to supplement replacement buying which is unusually heavy in anticipation of improved foundry operations this year. Foreign inquiry and actual sales are large, and a marked increase in exports are expected for the first months of the year. The November shipments of foundry and molding machinery according to a report of the department of commerce totaled $49,368 in value. The North Buffalo Hardware Foundry, 747 Hertel Ave., and the Standard Foundry Co., 743 Hertel Ave., Buffalo, related concerns, are contemplating the installation of labor saving machinery to lessen the required amount of unskilled labor. J. H. Vought is purchasing agent for both these foundries. Hatfields, Ltd., Sheffield, England, is installing a 360 kilowatt, car type electric furnace for the heat treatment of manganese steel castings. This unit is manufactured by the Electric Furnace Co., Salem, O. The Pangborn Corp., Hagerstown, Md., is installing sand blast equipment at the plant of the Farrel Cheek Steel Foundry Co., Sandusky, O.

Chicago District Inquiry Brisk

CONTINUED and increasing activity of foundries the country over is reflected in purchases of equipment to extend their operation, as well as in other equipment to replace that used up in natural destruction. In the former class are cupolas, tumbling barrels and cranes, and in the latter ladles, trucks and general supplies. Manufacturers of the latter class of material find they cannot turn out ladles fast enough to meet demands and are behind in their orders, both for the large geared ladles and for the smaller varieties. Demand for trucks and other items of smaller equipment are also beyond the ability of makers to keep up. An unusual demand for cupolas is now being met. The Whiting Corp., Harvey, Ill., has booked six, 60-inch special cupolas, for the Ford Motor Co., Detroit; a 120-inch cupola for the new foundry of the Pullman Co., Chicago; a 66-inch special cupola for the Buick Co., Flint, Mich.; a 32-inch cupola for the American Foundry Co., Los Angeles; a 66-inch cupola for the Birmingham Machine & Foundry Co., Birmingham, Ala.; and a 72-inch special cupola for the Westinghouse Airbrake Co., Pittsburgh. The same maker has booked a 42 x 60-inch tumbling barrel for Fairbanks, Morse & Co., Beloit, Wis., two 42 x 72-inch tumbling barrels for the Birmingham Machine & Foundry Co., Birmingham, Ala.; and a 42 x 72-inch tumbling barrel for the Ingersoll-Rand Co., New York. The Pacific Car & Foundry Co. has purchased a 60-ton electric traveling crane for its Portland, Ore., plant from the Whiting Corp. The foundry of the Pullman Co., Chicago, which will be a continuous foundry producing car wheels, is well along in construction and probably will begin production about April 1. It is being built by Frank D. Chase, Inc., Chicago. Foundry engineers have numerous prospects for new foundries or additions and are working on preliminary plans which have not yet gone to the point of starting construction. The Buick Motor Co., Flint, Mich., is installing a third furnace for melting brass. This furnace was built by the Electric Furnace Co., Salem, O. The Metal & Thermit Co. has purchased a furnace of 200 kilowatt capacity from the same firm, to be installed at the East Chicago, Ind., plant. The Semi-Steel Casting Co., St. Louis, has placed a 5-ton, 45 foot span crane and the Michigan Stove Works, Detroit, a 3-motor, 27-foot span crane with the Northern Engineering Works, Detroit. The Belle City Malleable Iron Co., Racine, Wis., is going ahead with building operations. The South Side Malleable Castings Co., Milwaukee, is extending its shop to accommodate another melting furnace, and probably will buy additional equipment. The Buick Motor Co., Flint, Mich., and the Studebaker Corp., Detroit, have purchased sand blast equipment from the Pangborn Corp., Hagerstown, Md.

Outlook Bright in Pittsburgh

WITH a fair number of sales and a large number of inquiries, the foundry equipment market in the Pittsburgh district is considered active. Two or three additional molding machine orders have been taken by a large molding machine manufacturer in this district, but a large number of inquiries are up for consideration which give promise of early closing. A steel foundry interest is remodeling a building in the Pittsburgh territory to manufacture split molds. It will purchase two 6-foot cupolas, two jarring machines, an air compressor, blower etc. A new brass foundry interest in Monessen, Pa. wants a core oven, tumbling barrel, several steel flasks emery grinder, band saw, shovels, brushes, riddles, in addition to a brass furnace, core compounds, facings, sands, etc. The Kirk Supply Co. reports a fair movement of steel flasks recent purchasers including the Springfield Foundry Co., United Bronze Co., and the Kelly & Jones Co., all of Pittsburgh, and the Westinghouse Airbrake Co., Wilmerding, Pa. A few orders for wheelbarrows likewise have been placed. The Ridgway Dynamo & Engine Co., Ridgway, Pa., has closed upon a large sprue cutter. The Lawrence Foundry Co., Grove City, Pa., the National Foundry Co., Erie, Pa., and the Standard Foundry Co., Buffalo, N. Y., all are understood to be in the market for foundry equipment, and labor-saving machinery. The Pratt & Letchworth Co., Buffalo, is expected to enter the market soon since it is planning expansion. James B. Clow & Sons, Chicago, has purchased two 108-inch cupolas for its New Comerstown, O., plant. This order which was placed with the Whiting Corp., Harvey, Ill., includes mechanical charging equipment and a 7½-ton crane. The Velte Foundry & Machine Co., Mars, Pa., has not closed on much of the equipment to replace that damaged by fire several weeks ago, but is expected to place orders shortly. The Blackwood Electric Steel Corp., Parkersburg, W. Va., likewise will in all probability purchase additional foundry equipment now that its crane and electric furnace have been ordered and the contract awarded for its new building. Electric furnace makers report a fairly large number of inquiries pending on which early action is expected. Pattern-making equipment will probably be purchased at an early date by the

Anderson Pattern Works, Erie, Pa., which recently was incorporated to manufacture wood and metal patterns. The Ajax Iron Works, Corry, Pa., recently closed on a 5-ton, 3-motor electric traveling crane with 30-foot span with the Northern Engineering Works, Detroit. Recent sales of sand blast equipment by the Pangborn Corp., Hagerstown, Md., include the Columbiana Foundry Co., McKeesport, Pa., and the Clearfield Machine Shops, Clearfield, Pa.

Scattered Orders Feature Eastern Market

WHILE there have been no large individual orders in the Eastern foundry market, demand has been showing a distinct improvement. Foundry operations are increasing, and this in turn has brought out quite a few inquiries for equipment for replacement purposes. One large seller, with a plant in the middlewest, reports that bookings never before in the history of the organization have been as heavy at this time of the year. One manufacturer of sand cutters states that he is now sold ahead about three months on the heavier types, and another manufacturer, building cupolas, reports also several weeks business on his books. Export demand continues to drag, although it is believed that there will be an improvement, especially in buying by South America, owing to the involved European situation. A recent export order placed calls for a cupola, blowers and other miscellaneous foundry equipment for the Truxillo railroad. The New York Central railroad is purchasing some equipment for its foundry at Frankford, N. Y., and owing to a continued good demand for railroad equipment, such as cars and locomotives, the entire railroad field looks better now from the standpoint of the foundry equipment seller than it has for some time. The Pennsylvania railroad recently placed a large number of locomotives, a goodly portion of which will be built at its own shops at Altoona, and this has aroused some speculation among sellers as to whether some additional equipment will not be required. Eastern Steel Castings, Newark, N. J., continues to be an active buyer, having closed recently on some additional ladles. The Eastern Foundry Co. of Boyertown, Pa., also is regarded an active factor at this time. It is understood that a new foundry is to be established at Schuylkill Haven, Pa., by L. A. Whetstone and others. The Bayonne Steel Casting Co., Bayonne, N. J., has purchased sand blast equipment from the Pangborn Corp., Hagerstown, Md.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Fire recently damaged the plant of the General Bronze Foundry Co., Cleveland.

Fire recently damaged the plant of the Hamden Foundry, at Hamden, O.

The Atlas Foundry & Machine Co., Tacoma, Wash., recently increased its capital stock to $82,500.

The Richmond Sanitary Mfg. Co., Richmond, Cal., has awarded a contract for the erection of a plant addition.

The plant of the Frank Foundry & Machine Co., Davenport, Iowa, recently was damaged by fire.

The plant of the Wilson Foundry & Machine Co., Pontiac, Mich., recently was damaged by fire.

Rebuilding of its plant is planned by the Cheboygan Brass Foundry, Cheboygan, Mich. It was recently damaged by fire.

Erection of an addition to its plant is planned by the Republic Brass Co., Cleveland which recently obtained a permit to erect a building at a cost of $10,000.

The American Brake Shoe & Foundry Co., New York, has obtained a permit to erect a foundry building at Houston, Tex., to cost about $15,000.

Gohmann Bros., & Kahler, New Albany, Ind., are having plans prepared for the erection of a foundry addition to be built at an estimated cost of $30,000.

Plans are being prepared by the Reading Hardware Co., Reading, Pa., for the erection of a 1-story foundry and machine shop building.

The Lee Foundry & Machine Co., 420 Mill street, Plymouth, Mich., plans the erection of a 1-story foundry addition, to cost about $30,000.

Erection of a foundry building, one-story, 50 x 140 feet, is being planned by the Codde Brass & Aluminum Mfg. Co., Detroit.

Re-election of all the old officers and directors of the Kokomo Brass Works, the Byrne-Kingston Co. and the Hoosier Iron Co., affiliated companies, has been announced by J. W. Johnson, Kokomo, Ind., following a recent stockholders' meeting of the three companies. A satisfactory year was reported by the three organization and the outlook for 1923 was reported as exceptionally bright.

Capitalized at $7000 the General Foundry Co., Ft. Worth, Tex., recently was incorporated by B. N. Wadley, R. A. Stewart, and F. M. Stewart.

Evan J. Owen and associates have leased the old Fullington Foundry, Gadsden, Ala., and will operate it under the name of the Ajax Foundry Co.

The Keokuk Steel Casting Co., Keokuk, Iowa, is having plans prepared for the erection of a molding room addition, to be built at an estimated cost of $20,000.

The Forest City Foundry & Mfg. Co., 1220 Main street, Cleveland, has purchased a site on which it plans to erect a large foundry at a later date. Charles F. Seelbach is secretary of the company.

Erection of a steel and concrete addition to be used as a brass melting room and for metal storage purposes, has been completed for the Marion Brass & Bronze Foundry, Marion, O. R. A. Lau is general manager of the company.

The Cadillac Motor Car Co., Detroit, has started work on plans for rebuilding its aluminum plant which was damaged by fire recently. The fire did considerable damage to the equipment, the loss being estimated in excess of $15,000.

Contract to furnish the annealing, core oven, oil, air distribution and pyrometer equipment for the new plant of the Blackwood Electric Steel Co., Parkersburg, W. Va., recently was awarded F. J. Ryan & Co., Wesley building, Philadelphia.

Bronze castings, monel metal, etc., will be produced by the Alloys Foundry Co., 3334 West Thirty-fourth street, Chicago, which recently was incorporated. Temporary officers of the company have been named as follows: President, S. W. Booth Jr.; vice president, Allen Erickson, and secretary-treasurer, C. B. Carter. The company now is installing equipment.

New annealing facilities, costing in excess of $100,000, are being provided by the South Side Malleable Casting Co. of Milwaukee, of which Walter W. Lange, is president and general manager. Contracts have been let for a building, 175 x 250 feet, adjacent to the present shops at Fourteenth and Windlake avenues. H. A. Kroening & Co., 893 Layton boulevard, are the general contractors.

The Berks Foundry & Mfg. Co., Hamburg, Berks Co., Pa., which operates jobbing foundries at Hamburg, Pa., and Watsontown, Pa., has completed improvements to both of its plants. At Watsontown an addition has been made to the shipping and storage floors. At Hamburg a fireproof building, 60 x 140 feet, has been finished and is being equipped with modern machinery. This will enable the company to finish its own castings and the addition of a wooden and metal pattern department is being made.

The Inland Engineering Co., recently incorporated at Chicago, will produce manganese and chrome steel castings. Walter S. McKee, president and treasurer of the company, has been engaged in this industry for 18 years, formerly being vice president of the American Manganese Steel Co. Edward S. Black, vice president, has had considerable experience in designing special castings for steel mills, blast furnaces and ore docks. Eugene C. Bauer, a vice president, has been in the selling department of the manganese steel industry for the past 16 wears, while J. W. Plant, another vice president, has been engaged in the sale of special castings on the Pacific Coast for many years. In the engineering department Alfred Exton is chief engineer and Claud Rorabeck, consulting engineer, both of whom have been engaged in this line of work for many years.